ME520B

Anritsu

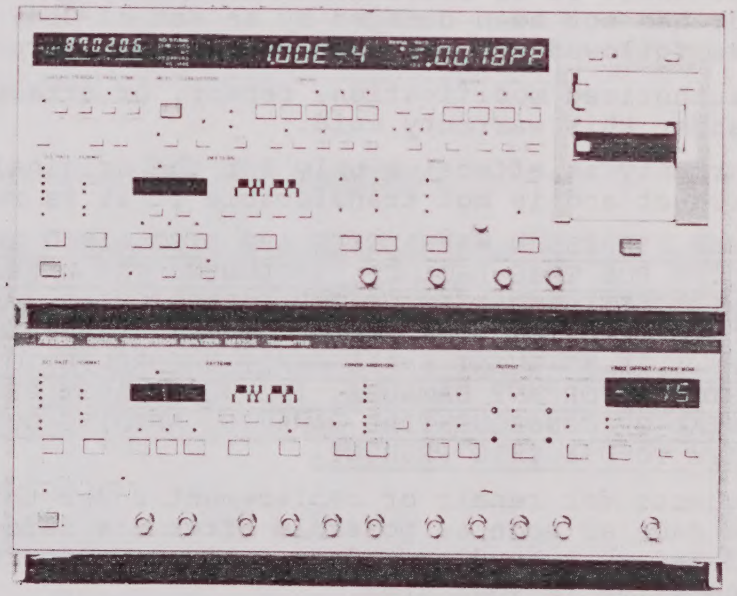
OPERATION MANUAL

Anritsu

OPERATION MANUAL

DIGITAL TRANSMISSION ANALYZER

ME520B



Printed in Japan
AUG. 1993x300 N(3)-36(Y)

CERTIFICATION

ANRITSU CORPORATION certifies that this instrument has been thoroughly tested and inspected, and found to meet published specifications prior to shipping.
Anritsu further certifies that its calibration measurements are based on the Japanese Electrotechnical Laboratory and Radio Research Laboratory standards.

WARRANTY

All parts of this product are warranted by Anritsu Corporation of Japan against defects in material or workmanship for a period of one year from the date of delivery. In the event of a defect occurring during the warranty period, Anritsu Corporation will repair or replace this product within a reasonable period of time after notification, free-of-charge, provided that: it is returned to Anritsu; has not been misused; has not been damaged by an act of God; and that the user has followed the instructions in the operation manual.

Any unauthorized modification, repair, or attempt to repair, will render this warranty void.

This warranty is effective only for the original purchaser of this product and is not transferable if it is resold.

ALL OTHER EXPRESSED WARRANTIES ARE DISCLAIMED AND ALL IMPLIED WARRANTIES FOR THIS PRODUCT, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO A PERIOD OF ONE YEAR FROM THE DATE OF DELIVERY. IN NO EVENT SHALL ANRITSU CORPORATION BE LIABLE TO THE CUSTOMER FOR ANY DAMAGES, INCLUDING LOST PROFITS, OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, ARISING OUT OF THE USE OR INABILITY TO USE THIS PRODUCT.

All requests for repair or replacement under this warranty must be made as soon as possible after the defect has been noticed and must be directed to Anritsu Corporation or its representative in your area.

Copyright © 1986 by ANRITSU CORPORATION Printed in Japan.
All rights reserved. No part of this manual may be reproduced in any form without written permission of ANRITSU CORPORATION.

WARNING

NO OPERATOR SERVICEABLE PARTS INSIDE.
REFER SERVICING TO QUALIFIED PERSONNEL.

CAUTION

FOR CONTINUED FIRE PROTECTION REPLACE
ONLY WITH SPECIFIED TYPE AND RATED FUSE.

Note:

1. The instrument is operable on a nominal voltage of 90 to 138 Vac or 180 to 250 Vac by changing the switch of the power supply.

   The voltage and current ratings are indicated on the rear panel when the instrument is shipped from the factory.

   To operate on the other voltage, change the switch of the power supply. (see paragraphs 3.5.1 and 3.6.1 of the service manual). The plate on the rear panel indicating the voltage and current ratings should be changed to the appropriate one. Order the plate from ANRITSU CORP. if needed.

2. In this manual, the power supply voltage and current ratings are represented by ** Vac and *** A, and **** A, respectively.

3. The relationship between power supply voltage and current rating is listed below.

** Vac (Workable)	(Transmitter) *** A	(Receiver) **** A
90 to 138	3.15	5
180 to 250	2	3.15

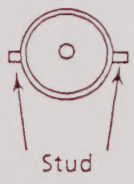
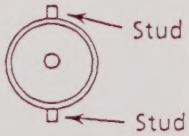
4. This instrument has battery backup for the memory. If the memory has not been backed up by the battery, the instrument will return to the initialized state. However, if the battery backup has been effective, the instrument will return and be set to the existing conditions immediately prior to the power being turned off.

MANUAL CHANGE

Option 01(built-in printer) is included with the ME520B as standard equipment.

BNC-TYPE CONNECTOR INSTALLATION

The BNC-type connector installation has been modified as follows:

Before Modification	After Modification
	

Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_06139

ERRATA (ME520B Ope.)

ITEM	DESCRIPTION		
	ERROR	CORRECT	rev. No.
P.3-128	Fig. 3-29	Fig. 3-29 (Attached sheet 1)	3.1
P.3-129	Fig. 3-30	Fig. 3-30 (Attached sheet 2)	

Attached Sheet 1

Fig. 3-29 ME520B RECEIVER
NRZ INPUT Static Phase Tolerance
(Typical data)

(See paragraph 3.4.3)

Attached Sheet 2

Fig. 3-30 ME520B RECEIVER
RZ INPUT Static Phase Tolerance
(Typical data)

TABLE OF CONTENTS

		Page
SECTION 1	GENERAL	1-1
SECTION 2	COMPOSITION AND SPECIFICATIONS	2-1
2.1	Composition	2-1
2.1.1	Composition	2-1
2.1.2	Options	2-2
2.2	Specifications	2-3
2.2.1	Transmitter specifications	2-3
2.2.2	Receiver specifications	2-12
SECTION 3	OPERATION	3-1
3.1	Safety Measures	3-1
3.1.1	Fuse replacement	3-1
3.1.2	Precautions	3-1
3.2	Layout of Controls	3-1
3.2.1	Transmitter front panel	3-2
3.2.2	Transmitter rear panel	3-10
3.2.3	Receiver front panel	3-14
3.2.4	Receiver rear panel	3-39
3.2.5	Transmitter internal switches	3-52
3.2.6	Receiver internal switches	3-53
3.2.7	Clock gating time	3-54

TABLE OF CONTENTS (Cont.)

		Page
3.3	Measurement Preparations	3-56
3.3.1	Installation site environment conditions	3-56
3.3.2	Power line voltage	3-56
3.3.3	Connection to power source	3-56
3.3.4	Self-testing	3-56
3.3.5	Built-in battery (for memory back-up) ...	3-57
3.4	Measurement	3-58
3.4.1	AMI, HDB3 bit error measurement (PRBS pattern)	3-60
3.4.2	CMI bit error measurement (Word pattern)	3-63
3.4.3	NRZ, RZ bit error measurement (PRBS pattern)	3-66
3.4.4	Status	3-71
3.4.5	AMI HDB3 jitter measurement (internal reference frequency)	3-73
3.4.6	CMI jitter measurement (internal reference frequency)	3-76
3.4.7	Clock jitter measurement (internal reference frequency)	3-79
3.4.8	Frequency offset method	3-82
3.4.9	Jitter modulation method 1 (When applying jitter modulation to the internal clock)	3-83
3.4.10	Jitter modulation method 2 (When applying jitter modulation to the external clock)	3-84
3.4.11	Jitter measurement using external standard clock	3-86

TABLE OF CONTENTS (Cont.)

		Page
3.4.12	Clock frequency measurement	3-87
3.4.13	Error measurement analyzing	3-88
3.4.14	139.264 Mb/s CMI jitter measurement using MP547A	3-96
3.4.15	Error rate recording	3-99
3.4.16	Thermal printer output (Option 01)	3-102
3.4.17	Printing paper replacement	3-116
3.4.18	External printer printing (TALK-ONLY → LISTEN-ONLY)	3-118
SECTION 4	PRINCIPLE OF OPERATION	4-1
4.1	Transmitter Operation Principle	4-1
4.2	Receiver Operation Principle	4-3
4.3	Bit Error and Code Error Detection	4-5
4.3.1	PRBS Bit Error Detection	4-5
4.3.2	WORD Bit Error Detection	4-7
4.3.3	CMI Code Error Detection	4-10
4.3.4	AMI Code Error Detection	4-12
4.3.5	HDB3 Code Error Detection	4-14
4.4	Error Count and Error Interval Measurement	4-16
4.5	Jitter-Hit Detection	4-18
4.6	Jitter-Hit and Jitter-Hit Interval Measurement	4-19

TABLE OF CONTENTS (Cont.)

		Page
SECTION 5	GP-IB INTERFACE	5-1
5.1	General	5-1
5.2	Outline of GP-IB System	5-1
5.2.1	Outline	5-1
5.2.2	Bus line descriptions	5-3
5.2.3	Three-wire Handshake	5-6
5.2.4	Cable connections	5-8
5.3	Measurement Preparations	5-9
5.3.1	GP-IB ADDRESS setting	5-10
5.3.2	Device modes	5-13
5.3.3	TALK-ONLY mode	5-16
5.3.4	ADDRESS 0 mode	5-17
5.4	GP-IB Measurement Flowchart	5-25
5.5	PACKET III Sample Program	5-28
SECTION 6	PERFORMANCE CHECK	6-1
6.1	Introduction	6-1
6.2	Equipment Reuired for Performance Checks ...	6-2
6.3	Preliminary Operations	6-4
6.4	Transmitter Performance Check	6-4
6.4.1	Internal clock frequency accuracy and offset check	6-4

TABLE OF CONTENTS (Cont.)

		Page
6.4.2	External clock frequency and amplitude check	6-8
6.4.3	Clock output check	6-11
6.4.4	PRBS pattern check	6-15
6.4.5	PRBS zero substitution check	6-18
6.4.6	1-16 bit word pattern check	6-22
6.4.7	2x8 bit word pattern check	6-25
6.4.8	Bit error addition check	6-28
6.4.9	Code error addition check	6-33
6.4.10	AMI, HDB3 output check	6-38
6.4.11	CMI output check	6-41
6.4.12	NRZ, RZ output check	6-42
6.4.13	EXT jitter modulation input check	6-47
6.4.14	2048 kb/s HDB3 pulse characteristics check	6-55
6.4.15	8448 kb/s HDB3 pulse characteristics check	6-58
6.4.16	34368 kb/s HDB3 pulse characteristics check	6-61
6.4.17	139264 kb/s CMI pulse characteristics check	6-64
6.5	Receiver Performance Check	6-69
6.5.1	AMI, HDB3 input check (For TERM mode) ...	6-69
6.5.2	AMI, HDB3 input check (For MON mode)	6-75

TABLE OF CONTENTS (Cont.)

		Page
6.5.3	AMI, HDB3 input check (For TERM mode, amplitude equalization)	6-80
6.5.4	CMI input check (For TERM mode)	6-85
6.5.5	CMI input check (For MON mode)	6-90
6.5.6	CMI input check (For TERM mode, amplitude equalization)	6-94
6.5.7	CLOCK input, NRZ RZ input check	6-98
6.5.8	REAL TIME setting check	6-103
6.5.9	GATING PERIOD setting check	6-106
6.5.10	SINGLE/REPEAT, LAST DATA/CURRENT DATA setting check	6-115
6.5.11	STATUS display check	6-120
6.5.12	ERROR MODE, ERROR-DISPLAY MODE check	6-126
6.5.13	ERROR PERFORMANCE check	6-139
6.5.14	JITTER-DISPLAY MODE, HIT THRESHOLD check	6-146
6.5.15	JITTER DEMOD-OUTPUT check	6-156
6.5.16	JITTER REF CLOCK-OUT check	6-159
6.5.17	JITTER REF CLOCK-IN check	6-163
6.5.18	JITTER MEASURE-INPUT check	6-167
6.5.19	CLOCK MONITOR-OUTPUT check	6-170
6.5.20	DATA-OUTPUT/PATTERN SYNC-OUTPUT check ...	6-174
6.5.21	ERROR-OUTPUT check	6-179

TABLE OF CONTENTS (Cont.)

		Page
6.5.22	NO SIGNAL (status) OUTPUT check	6-182
6.5.23	SYNC LOSS (status) OUTPUT check	6-185
6.5.24	ERROR RATE OUTPUT check	6-188

APPENDIX

OPERATION MANUAL
DIGITAL TRANSMISSION ANALYZER
ME520B EXTERNAL DATA (OPTION 04)

SECTION 1

GENERAL

The Digital Transmission Analyzer ME520B measures digital errors of bit rates from 1 kbit to 150 Mbit/s (up to 170 Mbit/s with option 02), and digital timing jitter of clock frequencies from 700 kHz to 150 MHz (up to 170 MHz with option 02).

This analyzer is ideal for development and maintenance of 1st to 4th order digital line transmission systems, digital radio transmission systems, and digital optical transmission systems, including the 10CH system of the PCM 30CH system (CEPT).

The input/output interface conforms to CCITT Rec. G.703, the pseudorandom pattern conforms to CCITT Rec. 0.151, and jitter measurement conforms to CCITT Rec. O.171.

The ME520B consists of a transmitter and a receiver. End-to-end and loop-back tests can be performed with a single ME520B unit.

The transmitter can output pseudorandom (PRBS 2^{10}-1, 2^{15}-1, 2^{23}-1), 1 to 16 bit variable length programmable words, and 2 x 8 bit alternate word patterns as NRZ and RZ unipolar signals, AMI and HDB3 bipolar signals, and also in CMI signal formats. Bit and code error addition, internal clock frequency offset, and jitter modulation by external signals are possible by adding functions.

The receiver can measure digital errors of unipolar, AMI, HDB3, and CMI signals. Jitter measurement is also possible with clock signals or code signals (clock regenerated internally). Digital error and jitter are simultaneously measured and analyzed and the results are displayed digitally . The measured results can be printed out with a built-in thermal printer (option 01) and can also be stored.

The GP-IB interface is standard for both the transmitter and the receiver unit; it is convenient for automatic measurements.

The ME520B can further perform error analysis conforming to CCITT Rec. G.821 and is convenient for international comdigital network evaluation.

SECTION 2

COMPOSITION AND SPECIFICATIONS

2.1 Composition

2.1.1 Composition

Table 2-1 Standard Composition

Item	No.	Name	Qty.	Remarks
Measuring Equipment	#1	Transmitter	1	OPT: 02, 21, 22, 23, 24, 25, 26, 27, 29, 30, 32, 33
	#2	Receiver	1	OPT: 01 (with 6 rolls of Thermal Paper), 02
Accessories	#3	Cable A01	4	3C-2V (2 m) BNC-P BNC-P
	#4	Cable A01 (Optional)		
	#5	Cable A02 (Optional)		For GP-IB, (2 m)
	#6	Ac Power Cord	2	
	#7	Fuse	1 set	

		100%	200%	300%
For Transmitter	*** A:	2	4	6
	8 A:	2	4	6
	3.15 A:	1	2	3
	0.8 A:	1	2	3
For Receiver	**** A:	2	4	6
	8 A:	3	6	9
	1 A:	2	4	6

*** A = 3.15 A, **** A = 5 A	90 V to 138 V
*** A = 2 A, **** A = 3.15 A	180 V to 250 V

#8	Thermal Paper	6 Rolls	For Printer (Option 01)
#9	Operation Manual	1	
#10	Service Manual	1	

2.1.2 Options

Table 2-2 List of Options

Option No.	Option Name	Remarks
02	Maximum operating frequency: 170 MHz	Format: NRZ, RZ
04*	External data	Only to transmitter See APPENDIX
21*	Additional clock 35.008 MHz	Only to transmitter
22*	Additional clock 41.2416 MHz	Only to transmitter
23*	Additional clock 104.448 MHz	Only to transmitter
24*	Additional clock 141.040 MHz	Only to transmitter
25*	Additional clock 141.248 MHz	Only to transmitter
26*	Additional clock 141.475 MHz	Only to transmitter
27*	Additional clock 167.1168 MHz	Only to transmitter with Option 02
29*	Additional clock 32.064 MHz	Only to transmitter
30*	Additional clock 110.592 MHz	Only to transmitter
32*	Additional clock 143.360 MHz	Only to transmitter
33*	Additional clock 30.720 MHz	Only to transmitter
34*	Additional clock 64 kHz	Only to transmitter
35*	Additional clock 25.776 MHz	Only to transmitter
36*	Additional clock 8.192 MHz	Only to transmitter
37*	Additional clock 70.848 MHz	Only to transmitter
38*	Additional clock 34.724 MHz	Only to transmitter
40*	Additional clock 168.443 MHz	Only to transmitter
42*	Additional clock 35.840 MHz	Only to transmitter
43*	Additional clock 35.9391 MHz	Only to transmitter
44*	Additional clock 155.520 MHz	Only to transmitter with Option 02
45*	Additional clock 125.000 MHz	Only to transmitter
46*	Additional clock 10.000 MHz	Only to transmitter

* Only one option with the mark * is furnished with the ME520B.

2.2 Specifications

2.2.1 Transmitter specifications

Bit Rate

Internal clock

Bit rate:	704, 2048, 8448, 34368, 68736, 139264 kb/s
Accuracy:	$\leq$ ±2 ppm at ambient temperature
Stability:	Typically $\leq$ ±5 ppm/0° to 50°C Typically $\leq$ ±2 ppm/year aging
Offset:	0 to ±100 ppm in 1 ppm steps

External clock (rear panel)

Frequency:	1 kHz to 150 MHz (Option 02: 1 kHz to 170 MHz)
Impedance:	Nominal 75 Ω unbalanced
Termination:	Ground
Amplitude:	0.3 to 3 Vp-p, 1 kHz to 1 MHz (square wave)
	> 1 MHz (sine or square wave), limits ±3 V
Duty cycle:	50%

Clock Output

Numbers:	2 separate buffered outputs, common phase
Polarity:	Selectable CLOCK or $\overline{\text{CLOCK}}$
Level:	Selectable TTL, ECL, or manually SET
TTL	- TTL level (high state = 2.5 V/ low state = 0.5 V, approximately)
ECL	- ECL level
SET	- Amplitude 1 to 2 V, offset 0 to ±2 V

Clock Output (cont.)

Format:	Square wave, 50 ±10% duty cycle on internal clock
Impedance:	75 Ω unbalanced

Pattern

PRBS:	pseudorandom binary sequence
$2^{10}-1$	- Inverted signal
$2^{15}-1$	- Inverted signal, CCITT Rec. O.151
$2^{23}-1$	- Inverted signal, CCITT Rec. O.151

Word:

1-16 bit	- Freely programmable digital word, adjustable length 1 to 16 bits
2 x 8 bit	- Two 8-bit words, any possible setting, can be changed-over by an external control signal

Zero substitution (PRBS only)

The sequence can be disabled for 8 to 120 clock periods, in multiples of 8 clock periods. Zero substitution gating occurs in every sequence after the longest zero sequence in a PRBS pattern.

Pattern (cont.)

2 x 8 bit word control signal input (rear panel)

Impedance:	Nominal 1 kΩ unbalanced to ground
Amplitude:	0.25 to 10 Vp-p (sine or square wave), limit: +5 V, -5 V
Frequency:	Dc to 5 MHz
- ve voltage:	Bit nos. 1 to 8
+ ve voltage:	Bit nos. 9 to 16

Internally resolderable to TTL level

Low state:	Bit nos. 1 to 8
High state:	Bit nos. 9 to 16

Error Addition

Bit or code errors are added to the sending pattern.

Error rate:	10^{-3}, 10^{-4}, 10^{-5} and 10^{-6}
Single error:	1 error is produced for each depression of key.
External error:	Errors are added by external ECL leveled signal.

EXT ERROR input (rear panel)

Impedance:	Nominal 680 Ω unbalanced to -5.2V
Amplitude:	ECL level

One error is produced for each positive transition of the external signal.

Frequency:	Dc to 25% of the clock frequency

CMI, RZ, NRZ Output

CMI format (CCITT Rec. G. 703)

Bit rate:	1 kb/s to 150 Mb/s
Amplitude:	1 ±0.1 Vp-p
Overshoot:	$\leq$ 5% of measured p-p voltage
Numbers:	4 separate buffered outputs, common phase

Using internal switch, CMI can be set to ECL output.

RZ, NRZ format

Bit rate:	1 kb/s to 150 Mb/s (Option 02: 1 kb/s to 170 Mb/s)
Level:	Selectable TTL, ECL, or manual SET
TTL	- TTL level (high state = 2.5 V/ low state = 0.5 V, approx.)
ECL	- ECL level
SET	- Amplitude 1 to 2 V, offset 0 to ±2 V
RZ duty cycle:	50 ±10% on internal clock
NRZ width:	100 ±5%
Overshoot:	$\leq$ 10% of pulse amplitude
Numbers:	4 separate buffered outputs, each delayed 4 bits
Impedance:	75 Ω, unbalanced
Polarity:	DATA or $\overline{\text{DATA}}$, internally switched at the binary level

AMI, HDB3 Output

RZ HDB3 format (CCITT Rec. G. 703) or RZ AMI format

Bit rate:	1 kb/s to 50 Mb/s
Level:	Selectable 2.37 ±0.237 V/0 ±0.237 V or 1.0 ±0.1 V/0 ±0.1 V
+ ve/- ve Pulse amplitude ratio:	1.0 ±0.05
Overshoot:	≤ 10% of pulse amplitude
Numbers:	4 separate buffered outputs, each delayed 4 bits
Impedance:	75 Ω unbalanced

Jitter Modulation

Jitter modulation facility

Timing jitter can be added to the clock and data output signals by applying an external modulation source. All peak-to-peak jitter amplitudes and modulating frequencies meet CCITT Recommendation O.171. (See chain line in fig. 2-1 for Table 2-3.)
Maximum jitter amplitude: 10.10 UI-PP.

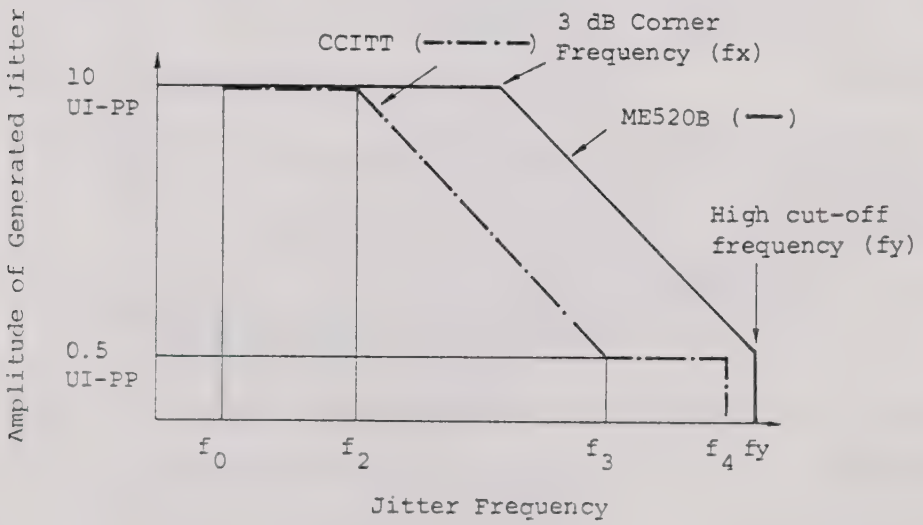


Fig. 2-1 Relationship between Generated Jitter Amplitude and Jitter Frequency

Table 2-3 Relationship between Jitter Modulation Frequency and Amplitude Characteristics of Transmitter

Bit Rate (kb/s)	CCITT Rec. O.171 f_0 (Hz)	f_2 (kHz)	f_3 (kHz)	f_4 (kHz)	ME520B f_x* (kHz)	f_y* (kHz)
704	——	——	——	——	4.5	35
2048	2	2.4	45	100	13	102
8448	2	10.7	200	400	50	422
34368	2	1.0	20	800	210	1,000
68736	——	——	——	——	300	2,000
139264	2	0.5	10	3,500	600	4,000
EXT	Jitter can be modulated within ±10% of the internal bit rate.					

* Typical values

Frequency range: Meets CCITT Rec. O.171 (Table 2-3) for sinusoidal modulation; typically dc to 5% or 2.5% of bit rate, shown in above figure and table.

Impedance: Nominal 75 Ω, unbalanced to ground

Sensitivity: Nominal 10 UI-PP/V (at 5 Hz)

Display: 0.00 to 10.10 UI-PP

Display Accuracy: ±5% ±0.1 UI-PP
Valid for periodic modulating frequencies down to 5 Hz

Reference clock output (unjittered, rear panel)

Impedance: Nominal low, unbalanced to ground

Amplitude: Nominal ECL level

External load: 50 Ω into -2 V

Other Input and Output

Pattern sync output (rear panel)

Format:

PRBS	- One pulse/sequence
2 to 16 bit word length	- One pulse/two sequences
1 bit word length	- One pulse/4 bits
2x8 bit word length	- One pulse/sequence

Width: Two clock periods (except with zero substitution when width stretched to approximately that of zero block).

Amplitude: Nominal ECL level

GP-IB Facilities

Scope: Used when ME520B Transmitter operates with an external controller; allows control of all switches except POWER, GP-IB ADDRESS, and level setting adjustment.

Functions: Overwrite any switch setting positions; request current display; request annunciators; request current switch positions and flags; "local lockout" facility; power-on initialization; service request(s) controllable by flags.

GP-IB Facilities (cont.)

LOCAL switch:	Allows switching from "REMOTE" to "LOCAL" control, except when the controller has issued a "local lockout" command.

Implementation:

SH1	- Source handshake (Complete capability)
AH1	- Accepter handshake (Complete capability)
T5	- Talker (Basic talker, Serial pole, TALK-ONLY mode, Unaddress if MLA)
TE0	- Extended talker (No capability)
L4	- Listener (Basic listener, unaddress if MTA)
SR1	- Service request (Complete capability)
RL1	- Remote local (Complete capability)
PP0	- Parallel poll (No capability)
DC1	- Device clear (Complete capability)
DT0	- Device trigger (No capability)
C0	- Controller (No capability)

Controlling flags

Sufficient flags are provided for the ME520B. Flags do not change even if a power failure occurs.

General

Non-volatile memory

A memory with a back-up battery ensures that the front panel set-up is not lost by instrument power failure. When power is restored, a check is made to confirm successful retention of memory. In the event of unsuccessful retention, the front panel is set to the default setting. The back-up battery will last a minimum of 1.5 months.

Power

** Vac (max. 250 V), 50/60 Hz, approximately 200 VA.
(See NOTE at the beginning of this manual.)

Dimensions and weight

132.5 H, 426 W, 351 D mm, approximately 11 kg

Environmental specifications

Operating temperature:	0° to 50°C
Storage temperature:	-20° to 70°C

2.2.2 Receiver specifications

Bit Rate

Internal clock recovery

Recovery rate: 704, 2048, 8448, 34368, 68736, 139264 kb/s

Pulling range:

Table 2-4 Pulling Range of Bit Rate, Receiver

Bit Rate (kb/s)	AMI	HDB3	CMI
704	±100 ppm	±3%	——
2048	±100 ppm	±3%	——
8448	±100 ppm	±3%	——
34368	±100 ppm	±3%	——
68736	——	——	±1%
139264	——	——	±3%

* (±50 ppm for jitter measurement)

Maximum zeros in pattern with AMI:
24 zero substitution in $2^{15}-1$ PRBS pattern

Pattern

PRBS: Pseudorandom binary sequence

$2^{10}-1$ - Inverted signal

$2^{15}-1$ - Inverted signal, CCITT Rec. O.151

$2^{23}-1$ - Inverted signal, CCITT Rec. O.151

Word:

1-16 bit - Freely programmable digital word, adjustable length 1 to 16 bits

Zero substitution (PRBS only)

The sequence can be disabled for 8 to 120 clock periods, in multiples of 8 clock periods. Zero substitution gating occurs in every sequence after the longest zero sequence in a PRBS pattern.

Clock Input

Polarity:	Selectable CLOCK (+ve transition) or $\overline{\text{CLOCK}}$ (-ve transition)
Threshold:	Automatic, ground, or ECL threshold (coupled with termination switch)
Termination:	Ground or nominal -2 V (via switch)
Frequency:	1 kHz to 150 MHz (Option 02: 1 kHz to 170 MHz)
Impedance:	75 Ω unbalanced
Amplitude:	0.3 to 3 Vp-p,limits ±3 V

NRZ, RZ Input

Bit rate:	1 kb/s to 150 Mb/s (Option 02: 1 kHz to 170 Mb/s)
Threshold:	Manual -3 V to +3 V; ground or ECL threshold (coupled with termination switch)
Termination:	Ground or nominal -2 V (via switch)
Impedance:	75 Ω unbalanced
Amplitude:	0.3 to 3 Vp-p, limits ±3 V
Polarity:	DATA or $\overline{\text{DATA}}$, internally, switched at the binary level

CMI Input

Terminated mode

Threshold:	Ground
Termination:	Ground
Impedance:	75 Ω unbalanced,
Amplitude:	Automatic $\sqrt{f}$ equalization

CMI Input (cont.)

Table 2-5 CMI Input Amplitude for Bit Rate, Receiver

Bit Rate (kb/s)	Normal Voltage	Max. $\sqrt{f}$ Loss at 1/2 Bit Rate
68726	1 Vp-p	17 dB
139264	1 Vp-p	12 dB

Monitor mode
Additional gain: 26 dB to 30 dB

Polarity

DATA or $\overline{\text{DATA}}$, internally switched at the binary level

AMI, HDB3 Input

Terminated mode

Input: Ac coupled (1 µF)

Impedance: 75 Ω unbalanced

Amplitude: Automatic $\sqrt{f}$ equalization

Table 2-6 AMI, HDB3 Input Amplitude for Bit Rate, Receiver

Bit Rate (kb/s)	Nominal Peak Voltage of Marks (Pulse)	Nominal Voltage of Spaces (No Pulse)	Maximum $\sqrt{f}$ Loss at 1/2 Bit Rate
704	2.37 V	0 V	3 dB
2048	2.37 V	0 V	6 dB
8448	2.37 V	0 V	6 dB
34368	1.0 V	0 V	12 dB

Monitor mode

Additional gain:	30 dB for 704, 2048, 8448 kb/s, 26 dB for 34368 kb/s
Polarity:	DATA or $\overline{\text{DATA}}$, internally switched at the binary level

Error Measurement

Mode:	3 error modes
Bit error:	For PRBS and WORD Closed loop bit-by-bit detection at binary level
Code error:	For AMI, HDB3 and CMI codes, code violation detection as follows:
AMI	- Bipolar violations are code errors
HDB3	- "Violation of violations" rule, i.e., two consecutive bipolar violations with same polarity
CMI	- "Violation of CMI coding rules," i.e., two consecutive bits, whose intervals are one full unit time, with same polarity
Block error:	For PRBS only, the block length coincides with the length of the PRBS, an error is detected in a block which contains one or more bit errors

Pattern synchronization

Mode:	Automatic or manual
Sync loss:	PRBS; approximately 10,000 errors per 30,000 clock periods WORD; approximately 1,000 errors per 30,000 clock periods

Sync gain:	PRBS; no error in 32 clock periods WORD; no error in 32 to 512 clock periods

Error Display Mode

Error rate (ERROR RATE)

Method:	Totals errors over selected gating period and automatically scales results
Gating:	Internal gating or manual gating are selectable.
Display:	0.00E - MN LED (0.00×10^{-MN})
Range:	MN = 1 to 15 with automatic scaling.
Accuracy:	Indication given if measurement result is based on < 100 errors

Error count (ERROR COUNT)

Method:	Totals errors over selected gating period
Gating:	Same as that of ERROR RATE
Display:	6 digit LED display with leading zero blanking
Range:	When count exceeds 999999, display automatically changes to 0.00E00 with automatic round-up to a maximum count of 9.99E15 (9.99×10^{15})

Error intervals (ERROR INTVLS)

Method:	Totals the number of intervals (1, 0.1, 0.01 s) which contain one or more errors. (These intervals can be selected by the rear panel switch.)

Gating:	Same as that of ERROR RATE
Display:	Same as that of ERROR COUNT
Range:	Same as that of ERROR COUNT

Error free intervals % (ERROR F INTVLS %)

Method:	Totals the number of intervals (1, 0.1, 0.01 s) during which no errors occur over selected gating period
Gating:	Same as that of ERROR RATE
Display:	A six-digit LED display with leading zero blanking from 0.000% to 100.000% (max).

Error Performance

The basic analytical method is the same as CCITT Rec. G.821.

The measurement evaluation period is set by the START/STOP key. This period is the S total in seconds. For the error performance, during the measurement evaluation period, errors are measured for each one-second interval and the result is evaluated. The error performance parameters normally consist of the unavailable seconds, degrated minutes, severely errored seconds, and errored seconds. In addition, by switching the internal switch, the errored seconds can be converted to error-free seconds. These are all displayed as a percentage. The three items excluding the errored seconds of the error performance parameters can set each corresponding error threshold.

Each error threshold can be varied by using the key. The error performance parameters are defined for the following contents.

% Unavailable Seconds (% US):

A period of unavailable time begins when the error rate is worse than threshold 1 for a period of ten consecutive seconds. These ten seconds are considered to be unavailable time.

The period of unavailable time terminates when the error rate in each second is better than or equal to threshold 1 for a period of ten consecutive seconds. These ten seconds are considered to be available time.

Sunavail = number of unavailable time

Savail = number of available seconds
= (Stotal - Sunavail)

% US = (Sunavail/Stotal) x 100

threshold 1 = 10^{-2}, 10^{-3}, 10^{-4} selectable

% Severely Errored Seconds (% SES):

Within the Savail period, the total number of 1 second intervals exceeding threshold 2 are considered the severely errored seconds, Ses.

% SES = (Ses/Savail) x 100

threshold 2 = 10^{-2}, 10^{-3}, 10^{-4} selectable

% Degraded Minutes (% DM):

Exclude the Ses from the Savail period and consecutively group the remaining seconds intervals into packets of 60. The total number of packets exceeding threshold 3 are considered the degraded minutes, Md.

% DM = (Md x 60/Savail) x 100

threshold 3 = 10^{-5}, 10^{-6}, 10^{-7} selectable

% Errored Seconds (% ES):

Within the Savail period, the toal number of 1 second intervals containing at least a one-count error are considered the errored seconds, Se.

% ES = (Se/Savail) x 100

% Error Free Seconds (% EFS):

% EFS = 100 - % ES

Status Display

No signal: Indicates loss of signal

Sync loss: Indicates local pattern reference has lost sync: LED display remains lit for at least 100 ms.

AIS: Indicates ≦3 zeros in 848 clock periods for 704, 2048, 8448 kb/s and EXT

Indicates ≦3 zeros in 1,536 clock periods for 34368 kb/s

Indicates ≦4 zeros in 2,928 clock periods for 68736 and 139264 kb/s

LED display remains lit for at least 100 ms.

<100 Errors: Indicates error rate result based on < 100 errors

Record: LED display of this section remains lit for the measuring gating period in which each status occurs

Jitter Measurement

Peak-to-peak jitter

Range 1 UI: 0.000 to 1.010 UI-PP

Range 10 UI: 0.00 to 10.10 UI-PP

In DATA input, measured jitter amplitudes and frequencies meet CCITT Recommendation 0.171 (see fig. for Table 3). The nominal measurement ranges for the clock input are expanded up to bracket area in Fig. 2-2.

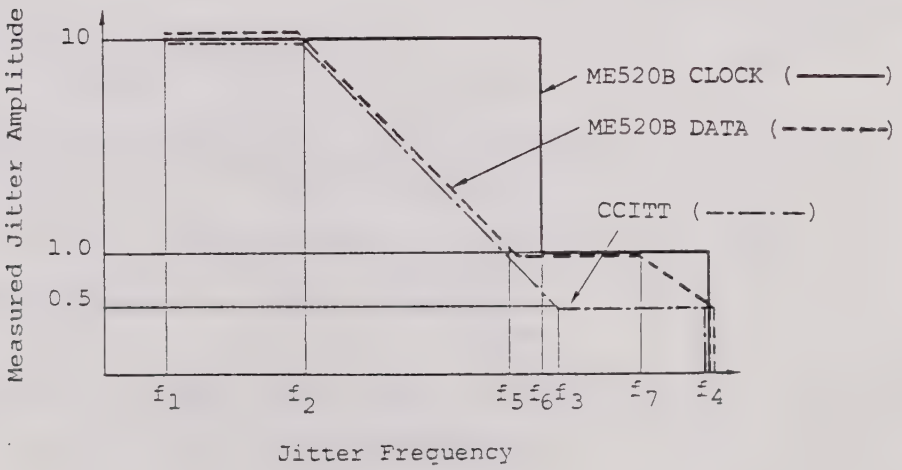


Fig. 2-2 Relationship between Measured Jitter Amplitude and Jitter Frequency

Table 2-7 Relationship between Measured Jitter Amplitude and Jitter Frequency

Bit Rate (kb/s)	CCITT Rec. O.171 f_1 (Hz)	f_2 (Hz)	f_3 (Hz)	f_4 (Hz)	ME520B (Typical) f_5 (Hz)	f_6 (Hz)	f_7 (Hz)
704	(20)	(1 k)	——	(35 k)	7 k	8 k	10 k
2048	20	2.4 k	45 k	100 k	24 k	27 k	30 k
8448	20	10.7 k	200 k	400 k	107 k	110 k	120 k
34368	100	1 k	20 k	800 k	10 k	344 k	320 k
68736	(100)	(40 k)	——	(1 M)	400 k	400 k	500 k
139264	200	500	10 k	3.5 M	100 k	500 k	1.4 M

Lower frequency limit: 20 Hz (Range 1)
5 Hz (Range 10)

Note:

Using the EXT JITTER REF CLOCK (on rear panel) and the slowest display rate, the lower frequency limit of the measurement bandwidth can be reduced to 0.1 Hz.

Display Rate:

FAST:	Valid for measurements of jitter frequency > 10 Hz
MED:	Valid for measurement of jitter frequency > 1 Hz
SLOW:	Valid for measurements of jitter frequency > 0.1 Hz (external jitter reference clock only)
Accuracy:	±4% ± additional error as shown below (with HP1, LP)

Jitter Measurement (cont.)

Table 2-8 Additional Error in Data and Clock for Range

Range	Additional Error in UIp-p				
	Data		Clock		
	HDB3	CMI	F≦50M	50M<F≦150M	F>150M (OPT 02)
Range 1	≦ 0.035	≦ 0.08	≦ 0.01	≦ 0.02	≦ 0.03
Range 10	≦ 0.12	≦ 0.24	≦ 0.1	≦ 0.2	≦ 0.3

Positive peak/negative peak jitter

Range: 1/2 specified range of the peak-to-peak jitter

Accuracy: With no filtering in the measurement path

Range 1 - ±5% ±0.01 ±additional error (as in peak-to-peak)

Range 10 - ±5% ±0.1 ±additional error (as in peak-to-peak)

Other specifications are same as peak-to-peak jitter measurement.

Internal filter

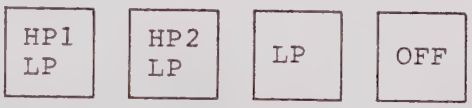
Internal filters meet CCITT Recommendation 0.171 except for slopes of low-pass filters.

Table 2-9 Nominal 3 dB Corner Frequencies of HP1, HP2 and LP for Bit Rate

Bit Rate (kb/s)	HP1 (Hz)	HP2 (Hz)	LP (Hz)
(704)	20	10 k	100 k
2048	20	18 k	100 k
8448	20	3 k	400 k
34368	100	10 k	800 k
(68736)	200	10 k	3.5 M
139264	200	10 k	3.5 M

Filters for 704 and 68736 kb/s are not specified by CCITT. All filters have a nominal 20 dB/decade slope asymptote.

Select one of the following combinations:



Note:

The HP2 filters for 2048 kb/s are for use with low-Q transmission systems.

The following measurements are made simultaneously. Any result can be accessed by using the DISPLAY key (this does not interrupt the measurement in progress).

Hit count (HIT COUNT)

Method: Totals the number of occurrences when the received jitter amplitude exceeds a manually settable threshold

Display: 6-digit LED display with leading zero blanking

Jitter Measurement (cont.)

Range:	When count exceeds 999999, display automatically changes to 0.00E00, with automatic round-up to maximum count of 9.99E15 (9.99×10^{15}).
Sensitivity:	Typically $\geq$ 100 ns pulse width counted.
Hit threshold:	User-defined in two ranges compatible with peak-to-peak jitter measurement
Range 1	0.050 to 0.500 UI peak
Range 10	0.50 to 5.00 UI peak
Typical accuracy	±5%

Hit intervals (HIT INTVLS)

Method:	Totals the number of intervals (1, 0.1, 0.01 s) in which one or more hits occur. The intervals can be selected by the rear panel switch.

Other specifications are the same as those of HIT COUNT.

Hit free intervals % (HIT F INTVLS %)

Method:	Totals the number of intervals (1, 0.1, 0.01 s) during which no hits occur.
Display:	Same as that of ERROR FREE INTERVALS %.

Other specifications are the same as those of HIT COUNT.

Maximum jitter peak-to-peak in gating period:

Holds the highest received peak-to-peak jitter amplitude measured during the gating period (last date mode only).

Reference clock input/output (rear panel)

Function:	Provides an output of the derived reference clock when using the internal reference, or serves as the input for an external reference clock.
Input/output selection:	Selected by rear panel switch.
Impedance:	Nominal 75 Ω, unbalanced to -2 V
Amplitude:	Nominal ECL level

Demodulated jitter output (on rear panel)

Impedance:	Operational Amplifier Output Impedance (nominal low impedance)
Amplitude:	
Range 1	1.0 V/UI-PP
Range 10	0.1 V/UI-PP
Dc content:	Typically $\leq$ 5 mV

Jitter measurement input (rear panel)

Selection:	Selected by rear panel switch.
Impedance:	Nominal 2.5 kΩ

Using the demodulated jitter output and jitter measurement input, the user can insert his own specific measurement filtering.

Gating Period

Manual gating:	START and STOP switch
Clock gating:	1 kHz $\leq$ F $\leq$ 1 MHz: 10^6 to 10^{12}, decade steps.
	1 MHz < F $\leq$ 10 MHz: 10^7 to 10^{12}, decade steps.
	10 MHz < F $\leq$ 100 MHz: 10^8 to 10^{12}, decade steps.
	100 MHz < F: 10^9 to 10^{12}, decade steps.

Gating Period (cont.)

Clock gating periods are set by being converted into time in steps of 0.1 seconds. Single or repetitive measurement.

Time gating:

1 s to 99-day single or repetitive measurement.

1 s to 1 min in 1 s steps.

1 min to 1 hour in 1-minute steps.

1 hour to 6 hours in 15-minute steps.

6 hours to 1 day in 1-hour steps.

1 day to 99 days in 1-day steps.

Note:

Measurement progress is displayed on the 10-segment LED bar display, indicating only elapsed time.

Mode: Single or repetitive

Real-Time Clock

Display:

YY MM DD or HH MM SS
(Y: Year; M: Month; D: Date; H: Hour; M: Minute; S: Second)

Setting:

Flashing digits can be set higher or lower. When timer is started by pushing the start button, the timer counts up from 00. (If the real-time mode is exited without pushing the start button, the timer remains at the last count prior to setting.)

Accuracy:

$\leq$ ±2 ppm at ambient temperature

Stability:

Typically $\leq$ ±5 ppm/0° to 50°C

Typically $\leq$ ±2 ppm/year aging

Typically $\leq$ ±20 ppm/power-down, at 25°C.

Evaluation

Last data mode

Displayed data and status record are the data in the last gating period.

Current data mode

Display data and status record are data in the current gating period, except Jitter UI, which displays the temporary value of jitter.
Progress data are issued for printer and GP-IB facilities. (See Printer Output Selection.)

Other Output

No signal status output (on rear panel)

Source:	Same as status display
Amplitude:	Nominal TTL Level

Sync loss status output (on rear panel)

Source:	Same as status display
Amplitude:	Nominal TTL level

Pattern sync output (on rear panel)

Format:

PRBS	- one pulse/sequence
2 to 16 bits word length	- one pulse/two sequences
1 bit word length	- one pulse/4 bits

Width:	Two clock periods (except with zero substitution when width stretched to approximately that of zero block)
Amplitude:	Nominal ECL level

Other Output (cont.)

Clock monitor output (on rear panel)

Source:	Recovered clock from AMI, HDB3, and CMI data inputs, or, front panel clock input
Amplitude:	Nominal ECL level

Error output (on rear panel)

Format:	One pulse/error
Amplitude:	Nominal ECL level

Data output (on rear panel)

Source:	Decoded AMI, HDB3, CMI, NRZ and RZ input data
Format:	Binary NRZ
Impedance:	Nominal low, unbalanced
Amplitude:	Nominal ECL level

Error rate output (on rear panel, for strip chart recorder)

Dc output votage proportional to exponent only of the measured result of error rate measurement: Variation in Dc 0.5 V steps from 10^{-15} to 10^{-2}. Dc output voltage updates at the end of each gating period.

GP-IB Facilities

General

Modes:	"ADDRESSABLE" or "TALK-ONLY" switch is selected (on rear panel).
Local switch:	Allows switching from "REMOTE" to "LOCAL" control, except when the controller has issued a "local lockout" command.

GP-IB Facilities (cont.)

Implementation:

SH1	-	Source handshake (Complete capability)
AH1	-	Acceptor handshake (Complete capability)
T5	-	Talker (Basic talker, Serial pole, TALK-ONLY mode, unaddress if MLA)
TE0	-	Extended talker (No capability)
L4	-	Listener (Basic listener, unaddress if MTA)
SR1	-	Service request (Complete capability)
RL1	-	Remote local (Complete capability)
PP0	-	Parallel poll (No capability)
DC1	-	Device clear (Complete capability)
DT0	-	Device trigger (No capability)
C0	-	Controller (No capability)

Controlling flags

Sufficient flags are provided for the ME520B. Except for the power alarm flag, these flags do not change even if power-down occurs.

Addressable mode

Scope: Used when the ME520B Receiver operates with an external controller; allows control of all switches except POWER, GP-IB ADDRESS, ADDRESSABLE/TALK-ONLY, and manual threshold setting of NRZ/RZ format.

GP-IB Facilities (cont.)

Functions:	Overwrite any switch setting position, request any of ten measured error data and seven measured jitter data; request annunciators; set real-time clock; request current switch positions and flags; "local lockout" facility; power-on initialization; service request(s) controllable by flags.

TALK-ONLY mode

Scope:	Used when ME520B Receiver operates without an external controller.
Functions:	Provide output message to a peripheral such as DPR7713A Printer connected in "LISTEN-ONLY" mode. Output result format and data are defined by 8-segment Printer Output Selection switch.

Printer Output Selection

The output condition is selected and the output data is set for the built-in printer and GP-IB (talk only). When the receiver is set for error performance measurement, this OUTPUT SELECTION is ignored, and print output format is changed to a special format for error performance data.

Print trigger:	Outputs the preset progress data if the data exceeds the threshold of the selected % SES, % DM, or % ES. The threshold is the same as that of the performance.
Output setting	Selects either 10 error and 7 jitter items, or the displayed error and jitter items, output.

GP-IB Facilities (cont.)

Self-testing

In combination with the transmitter, 12 items are tested automatically. Self-testing requires about 10 minutes.

General

Non-volatile memory

A memory with back-up battery ensures that the front panel set-up is not lost by instrument power-down. At power-up, a check is made to confirm successful retention of memory. If retention has been unsuccessful, the front panel is set to the default setting (i.e. initial setting).

Power supply

** Vac (max. 250 V), 50/60 Hz, approximately 230 VA. (See Note at the beginning of this manual.)

Dimensions and weight

177 H x 426 W x 351 D mm, approximately 15 kg

Environmental specifications

Operating temperature: 0° to 50°C

Storage temperature: -20° to 70°C

SECTION 3

OPERATION

3.1 Safety Measures

3.1.1 Fuse replacement

Be sure to unplug the ac cord before changing any fuses.

The fuses are in fuse holders above the ac inlet. To replace a fuse, remove the fuse holder with a flat bladed screwdriver, etc. There is one fuse on each side of the ac line. Be sure to check both fuses. Always use a new fuse of the same rating and type as the original fuse.

3.1.2 Precautions

If the instrument is moved to a high-temperature location after being used for a long time in a low-temperature location, (0°C, for example) condensation may form and cause a short circuit. Be sure to dry the instrument before turning on the power.

3.2 Layout of Controls

The transmitter front panel (T-1 to T-12), transmitter rear panel (T-13 to T-22), receiver front panel (R-1 to R-19), and receiver rear panel (R-20 to R37) are shown in Figs. 3-47 to 3-49.

3.2.1 Transmitter front panel (Fig. 3-1.)

Table 3-1 Transmitter Front Panel Functions

No.	Indication	Description
T-1	BIT RATE/FORMAT	
	BIT RATE (kb/s)	Bit rate selection key ° 704 : Internal clock frequency setting for 704 (kb/s) ° 2048 : Internal clock frequency setting for 2048 (kb/s) ° 8448 : Internal clock frequency setting for 8448 (kb/s) ° 34368 : Internal clock frequency setting for 34368 (kb/s) ° 68736 : Internal clock frequency setting for 68736 (kb/s) ° 139264: Internal clock frequency setting for 139264 (kb/s) EXT: Setting to external clock frequency (input connector is rear panel EXT CLOCK INPUT T-18) OPTION: (Refer to paragraph 2.1.2; Option Nos. 21 to 37) When a frequency is added as an option, that frequency is set. The frequency is increased sequentially from 704 kb/s each time the [BIT RATE] key is pressed and returns to 704 kb/s once it reaches the option bit rate.

Table 3-1 (Cont.)

No.	Indication	Description
T-1	BIT RATE (kb/s) (cont.)	When applying jitter modulation to the external clock, set [BIT RATE] to EXT and T-5 FREQ OFFSET/JITTER [MODE] to JITTER MODULATION. In this case, the external clock frequency can be input within a range of ±10% of the internal clock frequency. When in this mode, both the [BIT RATE] LED of EXT and the internal clock LED come on. If the [BIT RATE] key is held down, operation returns to the internal clock setting.
	FORMAT	Output format selection key ° AMI : AMI format setting (50 Mb/s or less) ° HDB3: HDB3 format setting (50 Mb/s or less) ° CMI : CMI format setting ° NRZ : NRZ format setting ° RZ : RZ format setting Changes sequentially from AMI to RZ each time the [FORMAT] key is pressed and returns to AMI when the end of sequence is reached.
T-2	PATTERN	Pattern setting key
	PRBS	[2^{10}-1] 10 stage pseudorandom pattern selector [2^{15}-1] 15 stage pseudorandom pattern selector (CCITT O.151) [2^{23}-1] 23 stage pseudorandom pattern selector (CCITT O.151)

Table 3-1 (Cont.)

No.	Indication	Description
T-2	PRBS (cont.)	ZERO SUBSTITUTION: A sequence can be gated off for 0 to 120 clock periods in steps of 8. Zero substitution gating occurs in every sequence after the longest PRBS pattern zero sequence. When the [OFF] key is pressed, zero substitution is cleared and the normal pseudorandom binary sequence is set.
	WORD	[1-16 BIT]: Word setting selection key The word length and word string are arbitrarily set and changed with the three setting keys and one clearing key. [SET 1] : Set to binary 1. [SET 0] : Set to binary 0. [MODIFY] : Specifies the word setting modification bit. Shifts to the right each time the key is pressed; returns to bit 1 when the key is pressed twice after the last bit. Returns to bit 1 when the key is pressed twice after the last bit. The blinking bit of the word display can be modified with [SET 1] or [SET 0]. [CLEAR] : Word setting clearing All the bits of the word display are erased and a new word can be set. Becomes binary zero when the [CLEAR] key is pressed. [2x8 BIT]: Word setting selection All bits must be set. The first 8 bits (LOW) and last 8 bits (HIGH) are output alternately by an external signal.

Table 3-1 (Cont.)

No.	Indication	Description
T-2	WORD (cont.)	The [SET 1], [SET 0], and [MODIFY] keys operate the same as for [1-16 BIT] operation. [CLEAR]: Clears the word setting (first 8 bits and last 8 bits). All bits of the word display are cleared to zero and only bit 1 blinks. A new word can be set.
T-3	ERROR ADDITION	Error insertion
	MODE	Bit : A bit error is inserted at binary level. CODE: A code error is inserted by the code set at FORMAT.
	RATE	OFF : Error not generated 10^{-6}: 1×10^{-6} error rate 10^{-5}: 1×10^{-5} error rate 10^{-4}: 1×10^{-4} error rate 10^{-3}: 1×10^{-3} error rate SINGLE: A single error is generated each time the [SINGLE] key is pressed. EXT : An error is generated when the external signal (ECL level) rises (T-15 EXT ERROR, INPUT).

Table 3-1 (Cont.)

No.	Indication	Description
T-4	OUTPUT	
	CLOCK	[POLARITY]: CLOCK and $\overline{\text{CLOCK}}$ switching
		° CLOCK: NRZ data are changed when the clock goes from low to high. The clock and RZ data remain in the same phase.
		° $\overline{\text{CLOCK}}$: NRZ data are changed when the clock goes from high to low. The clock and RZ data phases are 180° apart.
		[LEVEL]: Output level switching for CLOCK
		° TTL +2.5 V (H)/+0.5 V (L)...75 Ω ground termination
		° ECL -0.8 V (H)/-1.8 V (L)...75 Ω -2 V termination
		° SET °AMPLITUDE: 1 Vp-p to 2 Vp-p variable ...75 Ω ground termination °OFFSET: -2 V to +2 V variable
	NRZ RZ	[LEVEL]: Output level switching for NRZ, RZ
		° TTL +2.5 V (H)/+0.5 V (L)...75 Ω ground termination
		° ECL -0.8 V (H)/-1.8 V (L)...75 Ω -2 V termination
		° SET °AMPLITUDE: 1 Vp-p to 2 Vp-p variable ...75 Ω ground termination °OFFSET: -2 V to +2 V variable
	AMI HDB3	[LEVEL]: Output level switching for AMI, HDB3
		° 2.37 V Peak values +2.37 V and -2.37 V
		° 1 V Peak values +1 V and -1 V

Table 3-1 (Cont.)

No.	Indication	Description
T-5	FREQ OFFSET/ JITTER MOD	When [BIT RATE] is set to EXT, frequency offset function is turned OFF. [MODE]: Clock signal frequency offset and jitter modulation switching ° OFF Frequency is the value set at T-1, [BIT RATE]; a clean signal with less residual jitter is output. ° FREQ OFFSET Frequency offset is set with the [⩔] and [⩓] keys. A clean signal is output just as in the OFF state. ° JITTER MODULATION UI-PP The frequency is held at the value set at FREQ OFFSET and jitter is modulated by the signal input at T-11, EXT JITTER MODULATION, INPUT 75 Ω. The modulation degree is displayed by UI-PP. When applying jitter modulation to the external clock, see T-1, Table 3-1.
T-6	GP-IB	The ME520B has a GP-IB as standard equipment. This function is switched between REMOTE (with lamp), and LOCAL by a push-type switch. ° REMOTE The instrument is controlled by the controller via the GP-IB. It is also set to REMOTE during self-testing. For details, see SECTION 5, GP-IB Interface.

Table 3-1 (Cont.)

No.	Indication	Description
T-6	GP-IB (cont.)	° LOCAL The LOCAL key is effective except for REMOTE self-testing. All the keys and controls are effective in local mode.
T-7	PANEL LOCK	PANEL LOCK controls the following three modes: ° (Lamp) (a) Panel locked Inhibited except for the power switch and the four manual level adjustment, the same as the GP-IB remote mode. (b) Panel lock + lamp test Lamp test is done in the panel lock state described in (a). Lighting of all the lamps is confirmed. During measurement, pressing this key again releases panel lock and cancels the lamp test. (c) Normal mode Panel lock lamp goes out and the panel lock and lamp test are released.
T-8	CLOCK, OUTPUT	Unipolar clock output Output 1 and output 2 are the same phase. When Bipolar (AMI, HDB3) and CMI are set, this clock output is used for monitoring.

Table 3-1 (Cont.)

No.	Indication	Description
T-9	CMI, NRZ, RZ OUTPUT 75 Ω	CMI and unipolar data output CMI data outputs are the same phase for 1 to 4. Unipolar data outputs 1 to 4 are delayed, sequentially, every 4 bits. The unipolar output and clock time difference are 0.5 ns or less for RZ data, and 1.5 ns or less for NRZ data. When AMI or HDB3 is set, this unipolar output is turned off and is not output.
T-10	AMI, HDB3 OUTPUT 75 Ω	Bipolar output Outputs 1 to 4 are delayed, sequentially, every 4 bits. When CMI, NRZ, or RZ is set, this bipolar output is turned off and is not output.
T-11	EXT JITTER MODULATION INPUT 75 Ω	External jitter modulation input Modulation sensitivity is 10 UI-PP/V at 5 Hz. This input is dc-coupled. Static phase shift is also possible. Input impedance is 75 Ω.
T-12	POWER	Ac power switch The POWER indicator is a neon lamp and acts as the ac line primary side monitor. All LED lamps turn on for several seconds after the POWER is switched on for lamp testing. For safety, both sides of the ac line are turned ON/OFF.

3.2.2 Transmitter rear panel (See to Fig. 3-2.)

Table 3-2 Transmitter Rear Panel Functions

No.	Indication	Description
T-13	GP-IB	GP-IB connector Used during GP-IB operation and in the self-test and address zero modes.
T-14	ADDRESS/ TALK ONLY ON/OFF	(a) GP-IB operation is set at controller specified address. TALK-ONLY switch is set to OFF. (b) Self-testing and addressing zero modes; all switches are set to zero. (c) TALK-ONLY mode (Paragraph 5.3.3). The TALK-ONLY switch (left-hand side) is set to ON. In this setting, only the JITTER MODULATION UI-PP data can be displayed on the front panel by T-5.
T-15 to T-18 (INPUT)		
T-15	EXT ERROR INPUT (ECL)	This connector is used when the front panel T-3, ERROR ADDITION, is set to EXT. An error is generated every time the timing rises at ECL level input.
T-16	WORD 2x8 BIT INPUT	Input connector for WORD 2x8 BIT control signal. This is effective only when the front panel PATTERN switch T-2 is set to [2X8 BIT] WORD pattern. A +ve voltage is fed to output bits 1 to 8, and a -ve voltage is fed to output bits 9 to 16. When no signal is fed, bits 1 to 8 are output.

Table 3-2 (Cont.)

No.	Indication	Description
T-17	EXT CLOCK INPUT	External clock input connector The operating frequency is 1 kHz to 150 MHz. When option 02 (maximum frequency is 170 MHz) is specified, the operating frequency is extended from 1 kHz to 170 MHz. A squarewave signal is required for EXT CLOCK range of 1 kHz to 1 MHz.
T-18 to T-19 (OUTPUT)		
T-18	JITTER REF CLOCK OUTPUT (ECL)	Jitter free reference clock output connector (ECL level) This outputs the internal and external clock reference signals for connection to the receiver. It is used when the receiver measures a low frequency jitter of 20 Hz or less, or jitter other than that of the internal clock.
T-19	PATTERN SYNC OUTPUT (ECL)	Pseudorandom and word pattern period synchronization output connector (ECL level) PRBS - 1 pulse/period Word length 2-16 bits - 1 pulse/2 periods Pulse width - two clocks. When zero substitution is applied, the pulse width is expanded by that amount.
T-20	** V	Ac power inlet, connected to a three-pin ac-power cord

Table 3-2 (Cont.)

No.	Indication	Description
T-21	*** A	Two fuses, one on each side of the ac line. (See Note at beginning of this manual.) When replacing a fuse, always unplug the power cable. Both fuses must have the same rating and same type.
T-22		Ground terminal

* Blinking of transmitter LEDs

(1) Blinking of LEDs for GP-IB ADDRESS 0

Combinations are slightly restricted to meet CCITT specifications.

For combinations other than those shown below, the BIT RATE and FORMAT LEDs blink.
(When the LEDs blink, it means that the internal settings are being held at the last combination for which the LEDs did not blink.)

BIT RATE	FORMAT
704 to 34368	AMI, HDB3
68736 and 139264	CMI
All bit rates	NRZ, RZ

Note:

At 704 to 8448 kb/s for AMI and HDB3, the output level is set to 2.37 V. At 34368 kb/s for AMI and HDB3, the output level is set to 1 V.

(2) Blinking of LEDs for other than GP-IB ADDRESS 0

The combination of T-1 BIT RATE and FORMAT, LEDs blink with a BIT RATE and AMI or HDB3 combination that exceeds 50 Mbit/s when using an internal clock. (Example 68736-HDB3)

For combinations other than the above, LEDs do not blink.

(3) FORMAT T-1 and ERROR ADDITION MODE T-3 combination blinking

Both LEDs blink for NRZ or RZ and CODE combinations.

(4) FREQ OFFSET/JITTER MOD

(a) Jitter UI-PP numeric display blinking

When 10.10 UI-PP is exceeded, the numbers blink.

(b) OFF, JITTER MODULATION and FREQ OFFSET LEDs blinking

An AFC loop is generated within the specified frequencies, and each LED blinks until a stable frequency, within the specified value (T-1, T-5) is attained.

AFC operation is triggered by T-1 BIT RATE modification or T-5 FREQ OFFSET/JITTER MOD modification. When an exact BIT RATE is required, either of the above can be changed.

3.2.3 Receiver front panel (See Fig. 3-3.)

Table 3-3 Receiver Front Panel Functions

No.	Indication	Description
R-1	CLOCK INPUT 75 Ω	Used in unipolar signal (NRZ/RZ) error measurement and clock jitter measurement. This input connector is used when the front panel BIT RATE/FORMAT switch R-5 is set to EXT-NRZ/RZ. The clock conditions are set at CLOCK of front panel INPUT R-7. (75 Ω; input impedance)
R-2	NRZ, RZ INPUT 75 Ω	Also used in unipolar signal (NRZ/RZ) error measurement. This input connector is used when BIT RATE/FORMAT R-5 on the front panel is set to EXT-NRZ/RZ. The data input termination and threshold are set by NRZ/RZ of INPUT R-7 on the front panel. (75 Ω; input impedance)
R-3	CMI INPUT 75 Ω	Used for CMI signal error and CMI data jitter measurements. This input connector is used when BIT RATE/ FORMAT R-5 on the front panel is set to 68736 or 139264-CMI. (75 Ω; input impedance)
R-4	AMI, HDB3 INPUT 75 Ω	Used in bipolar signal (AMI, HDB3) error measurement and bipolar data jitter measurement. This input connector is used when BIT RATE/FORMAT R-5 on the front panel is set to 704, 2048, 8448 or 34368-AMI/ HDB3. (75 Ω; input impedance)

Table 3-3 (Cont.)

<table>
<tr><th>No.</th><th>Indication</th><th>Description</th></tr>
<tr><td>R-5</td><td>BIT RATE/FORMAT</td><td>[RECOVERY kb/s], [FORMAT]

Errors can be measured within the frequencies given in the following table.

<table>
<tr><th>Bit Rate (kb/s)</th><th>AMI</th><th>HDB3</th><th>CMI</th></tr>
<tr><td>704</td><td>±100 ppm</td><td>±3%</td><td>——</td></tr>
<tr><td>2048</td><td>±100 ppm</td><td>±3%</td><td>——</td></tr>
<tr><td>8448</td><td>±100 ppm</td><td>±3%</td><td>——</td></tr>
<tr><td>34368</td><td>±100 ppm</td><td>±3%</td><td>——</td></tr>
<tr><td>68736</td><td>——</td><td>——</td><td>+1%</td></tr>
<tr><td>139264</td><td>——</td><td>——</td><td>+3%</td></tr>
</table>

Jitter can be measured within the frequencies of the bit rate values of ±50 ppm mentioned above.

If the bit rate of the input data does not satisfy the above ratings or no signal is input, the LED blinks for each bit rate.</td></tr>
<tr><td>R-6</td><td>PATTERN

PRBS</td><td>Reference pattern at the receiver for error measurements.

[2^{10}-1]: Shift register 10-stage pseudorandom code

[2^{15}-1]: Shift register 15-stage pseudorandom code (CCITT O.151)

[2^{23}-1]: Shift register 23-stage pseudorandom code (CCITT O.151)

ZERO SUBSTITUTION: Each time [⩓] is pressed, zero substitution is performed from 0 to a maximum 120 bits in 8 bit steps. When the [OFF] key is pressed, zero substitution is cleared to zero and the pattern returns to the normal pseudorandom code.</td></tr>
</table>

Table 3-3 (Cont.)

No.	Indication	Description
R-6	PATTERN (cont.)	
	WORD	[1-16BIT]: Word setting selection key The word length and word string are arbitrarily set and modified with the following set and clear keys. [SET 1]: Set to binary 1. [SET 0]: Set to binary 0. [MODIFY]: Specifies the word setting modification bit. It shifts right each time the key is pressed. When [MODIFY] is pressed twice after the last bit, it returns to bit 1. The blinking bit of the word display can be modified with [SET 1] or [SET 0]. [CLEAR] : Clears the word setting. All the digits of the word display are erased and a new word can be set. When the [CLEAR] key is pressed, the output data is binary zero.
R-7	INPUT	
	CLOCK	[POLARITY]: CLOCK and $\overline{\text{CLOCK}}$ switching ° CLOCK The NRZ data are changed when the clock goes from low to high. The clock and RZ data phases match. ° $\overline{\text{CLOCK}}$ The NRZ data are changed when the clock goes from high to low. The clock and RZ data phases are 180° apart. [THRESHOLD/TERM]: Threshold value and termination conditions are switched.

Table 3-3 (Cont.)

No.	Indication		Description
R-7	CLOCK (cont.)	° AUTO/GND	The threshold value is set to the center value of high and low states of the input signal, and termination is to grounded.
		° GND/GND	The threshold value is ground level and termination is to ground.
		° ECL/-2 V	The threshold value is the center of the ECL level (-1.3 V), and termination is to -2 V.
	NRZ, RZ	[THRESHOLD/TERM]:	Threshold value and termination condition are switched.
		° MAN/GND	The threshold value is manually variable from -3 V to +3 V and termination is to ground.
		° GND/GND	The threshold value is ground level and termination is to ground.
		° ECL/-2V	The threshold value is the center of the ECL level (-1.3 V), and termination is -2 V.
	CMI, AMI, HDB3	[MODE]:	Selection switch for normal termination mode [TERM] or monitor mode [MON].
		° TERM:	Normal termination condition.
		° MON:	When connected to a protect monitor point, an amplifier is inserted to obtain the specified level.

Table 3-3 (Cont.)

No.	Indication	Description
R-8	GATING PERIOD/ REAL TIME	Set the measuring time and clock while watching the indicator. (R-10 shows the result.) [MODE]: Mode key to select (1) GATING PERIOD (upper row) or (2) REAL TIME (lower row). (1) GATING PERIOD ... upper row, selected according to function keys and corresponding lamp. [TIME] : Sets the measuring time in time units Set from 1 second to 99 days using SET keys [⩔] and [⩓] as follows: 1 second to 1 minute in 1-second steps 1 minute to 1 hour in 1-minute steps 1 hour to 6 hours in 15-minute steps 6 hours to 1 day in 1-hour steps In 1 to 99 day time gating period, the left TIME LED is lit and will be set in the following steps. 1 day to 99 days in 1-day steps

Table 3-3 (Cont.)

No.	Indication		Description
R-8	GATING PERIOD/ REAL TIME (cont.)	[CLOCK]:	Sets the number of measuring time clock units. Set by frequency from 10^6 to 10^{12} by SET keys [⩔] and [⩓] as follows: 1 kHz $\leq$ F $\leq$ 1 MHz: 10^6 to 10^{12}, decade steps. 1 MHz < F $\leq$ 10 MHz: 10^7 to 10^{12}, decade steps. 10 MHz < F $\leq$ 100 MHz: 10^8 to 10^{12}, decade steps. 100 MHz < F: 10^9 to 10^{12}, decade steps. Clock gating periods are set by being converted into time in steps of 0.1 seconds. Refer to paragraph 3.2.7 for details. Single or repetitive measurement.
		[MAN]:	The measuring time is set manually by [START/STOP] key of MEASURE/EVALUATION R-10.
		(2) REAL TIME ...	Lower row, selected according to function key and corresponding lamp.
		[YMD]:	Year, month, date display
		[HMS]:	Hour, minute, second display
		[⩔]:	Right shift key

Table 3-3 (Cont.)

No.	Indication	Description
R-8	GATING PERIOD/ REAL TIME (cont.)	When this key is pressed, the left end display blinks, the numbers are changed with SET keys [⩔] and [⩓], and the clock is set with the [START] key. Each time the right shift key [⩥] is pressed, the blinking position shifts to the right. It returns to the left end once it reaches the point farthest right. If shift key [⩥] is pressed when HMS is displayed, second display will indicate 00 and second setting cannot be made. When [START] key is pressed, display always starts from 00 second. [START]: The setting time starts when the [START] key is pressed.
R-9	GATING PERIOD/ REAL TIME ° AC PWR FAIL	GATING PERIOD/REAL TIME numeric display of R-8 - ac power failure display AC PWR FAIL: Ac power failure display If the ac power fails while the R-18 [POWER] switch is ON, the AC PWR FAIL lamp lights to notify the operator. In LAST DATA: Lights if ac power fails during the preceding measurement. In CURRENT DATA: Lights if ac power fails during the current measurement. Once the ac power is restored, the AC PWR FAIL lamp remains lit until the new gating period begins.

Table 3-3 (Cont.)

No.	Indication	Description	
		Numeric Display (1) GATING PERIOD	GATING LED Array Status
R-9	GATING PERIOD/ REAL TIME (Cont.)		
	(TIME)	The set gate time is displayed by hour, minute, and second each using two digits. (Hour-hour, Minute-minute Second-second format) When 1 to 99 day gate time, the gate time will be displayed in Day-day format.	10% of the set time is counted by the internal CPU and that elapsed time is displayed on the LED bars.
	(CLOCK)	The set gate time is displayed in 1E06 - 1E12 format. The gate time in 1E06 - 1E08 format cannot be set at some input frequencies (see R-8.)	10% of the set time is counted by the internal CPU and that elapsed time is displayed on the LED bars. If unacceptable gate time is set, the left and right end LEDs of the LED bar blink.

Table 3-3 (Cont.)

No.	Indication	Description	
R-9	GATING PERIOD/ REAL TIME (Cont.)	Numeric Display (1) GATING PERIOD	GATING LED Array Status
	(MAN)	The elapsed time from START is displayed by hour, minute, and second, each using two digits (Hour-hour, Minute-minute, Second-second format).	At first, 5 (half) LED bars light. At the end of measurement, all LEDs light momentarily, then go out.
		(2) REAL TIME YMD — Shows Year-year, Month-month, Date-date (Example 85.10.04; October 4th, 1985) HMS — Shows Hour-hour, Minute-minute, Second-second (Example 10.21.59; 10 hours, 21 minutes 59 seconds)	
R-10	STATUS	STATUS elective display STATUS LIVE (right-hand side LED) This is the current STATUS monitor. The display is the same in the LAST DATA and CURRENT DATA modes. STATUS RECORD (left-hand side LED) This records events to the present, excluding any <100 errors in CURRENT DATA mode. STATUS RECORD in CURRENT DATA mode: Records from the measurement start point to the current point.	

Table 3-3 (Cont.)

No.	Indication	Description
R-10	STATUS (cont.)	STATUS RECORD in the LAST DATA mode: Record during the preceding gating period. For details, see paragraph 3.4.4.
	NO SIGNAL:	The NO SIGNAL lamp lights when FORMAT R-5 is set to AMI, HDB3, CMI, or RZ and the data signal is not input at the input connector corres ponding to the code, or, the signal is turned off. The NO SIGNAL lamp also lights when FORMAT R-5 is set to NRZ, and the clock signal is either not input at CLOCK INPUT R-1, or is turned off.
	SYNC LOSS:	The SYNC LOSS lamp lights when the input data pattern and the pattern set at PATTERN R-6 do not match (under the sync loss conditions given below). When ERROR MODE is set to CODE, the SYNC LOSS lamp does not light. Sync loss conditions: (PRBS; 10,000 or more errors/30,000 clocks) (BLOCK; 10,000 or more errors/30,000 clocks) (WORD; 1,000 or more errors/30,000 clocks) The SYNC LOSS lamp does not light when the input data pattern and the pattern set at PATTERN R-6 match (under the sync gain conditions given below). Sync gain conditions: (PRBS; no errors during 32 clock periods) (Block; no errors during 32 clock periods) (Word; no errors during 32 to 512 clock periods)

Table 3-3 (Cont.)

<table>
<tr><th>No.</th><th>Indication</th><th>Description</th></tr>
<tr><td>R-10</td><td>STATUS (cont.)</td><td></td></tr>
<tr><td></td><td>AIS:</td><td>The AIS lamp is lit by consecutive binary 1s under the conditions given below.

AIS lighting conditions
<table><tr><th>RECOVERY RATE (kb/s)</th><th>Lighting Condition</th></tr><tr><td>704
2048
8448</td><td>Three or fewer binary level zeros in approximately 848 clocks</td></tr><tr><td>34368</td><td>Three or fewer binary level zeros in approximately 1536 clocks</td></tr><tr><td>68736
139264</td><td>Four or fewer binary zeros in approximately 2928 clocks</td></tr><tr><td>EXT</td><td>Three or fewer binary level zeros in approximately 848 clocks</td></tr></table></td></tr>
<tr><td></td><td><100 ERRORS</td><td>Indicates whether there are more than two significant digits in the error rate measurement. When the <100 ERRORS lamp is not lit, there are more than two significant digits in the error rate. To find the exact number of significant digits, check the error count display.

The <100 ERRORS lamp lights when the number of errors during measurement is less than 100, and it goes out when the number of errors exceeds 100.</td></tr>
</table>

Table 3-3 (Cont.)

No.	Indication	Description
R-10	STATUS (cont.)	The contents when measurement ends are recorded as LAST DATA. The left and right lamps light the same for the LAST DATA and CURRENT DATA mode.
R-11	MEAS/ EVALUATION	[START/STOP]: (Does not start if any control LED on the front panel is blinking.) Effective in all GATING PERIOD modes. [START/STOP] key is pressed to start and stop GATING PERIOD. When starting, LED is lit. When stopping, LED will go off. ° SINGLE : Single measurement ° REPEAT : Repeated measurement ° LAST DATA: Measured results of the preceding gating period. ° CURRENT DATA: Measured results at the current time. Updated every 100 ms.
R-12	ERROR	ERROR numeric display of R-13 ERROR: Lights for several 10 ms each time an error is detected. When errors are detected at short intervals, the lamp lights continuously. ERROR (numeric display): The error data set by R-13 [DISPLAY MODE] is displayed.

Table 3-3 (Cont.)

No.	Indication	Description
R-13	ERROR	Error settings
	[DISPLAY MODE]	Eight kinds of error data can be measured simultaneously. When the SHIFT key is not lit, error RATE, COUNT, INTVLS or F.INTVLS that is printed in black can be selected, and the contents of the selected parameter are displayed on the upper LED display. (normal mode) When the SHIFT key is lit, error performance parameter %US, %SES, %DM or %ES that is printed in blue on the panel can be slected, and the contents of the selected parameter are indicated by the upper LED display. (shift mode)
	[NORMAL MODE]	[error RATE]: Ratio of number of errors to total number of clocks. Displayed in 0.00E - 00 format. [error COUNT]: Error addition value. The display switches to exponential display (0.00 E00) when the number of errors exceeds 999,999. [error INTVLS]: Number of intervals (1 s, 0.1 s, 0.01 s) set at switches C, D, and E of rear panel ADDITIONAL FUNCTION R-23 at which one or more errors occurred. Error seconds are at 1 s intervals, error deciseconds are at 0.1 s intervals and error centiseconds are at 0.01 s intervals. The display switches to exponential display (0.00E00) when the number of error intervals exceeds 999,999. Interval and error pulse are asynchronous.

Table 3-3 (Cont.)

No.	Indication	Description
R-13	ERROR (cont.)	[error FREE INTVLS]: Selected by the same key as ERROR FREE INTVLS%. When the key is pressed, ERROR FREE INTVLS and ERROR FREE INTVLS% display are switched. Error free intervals subtracts the number of error intervals from the total number of intervals for the gating period. Error free seconds are at 1 s intervals, error free deciseconds are at 0.1 s intervals and error free centisecond are at 0.01 s intervals. The display switches to exponential display (0.00E00) when the number of error free intervals exceeds 999,999. [error FREE INTVLS %]: Ratio of the difference between the number of error intervals, and the number of intervals of the gating period, to the total number of intervals. (00.000%) When there are no errors in the measuring period, 100.000% is displayed.
	[SHIFT MODE]	Four kinds of error performance parameters can be measured simultaneously. The measurement results obtained during the period set by gating period is displayed for the four kinds of error performance parameters. The error rate threshold or error count threshold can be set for %US, %SES, or %DM. See ERROR THRESHOLD for details on threshold setting.

Table 3-3 (Cont.)

No.	Indication	Description
R-13	[SHIFT MODE] (cont.)	Error performance parameters are all indicated as a percentage of four decimal places. [%US] % Unavailable Seconds [%SES] % Severely Errored Seconds [%DM] % Degraded Minutes When the switch (S3-6) in CPU board Z12, is "1", the %DM display mentioned above becomes the % Degraded Ten Minutes display. [%ES] % Errored Seconds (Threshold is for only the error count threshold and is fixed at 0.) [%EFS] When the switch (S3-1) in CPU board Z12, is "1", the %ES display mentioned above becomes the %Error Free Seconds display. The decimal point is displayed at the least significant digit in the %Error Free Seconds measurement, and can be distinguished from the %ES measurement. But both results of the %ES, and the %EFS measurement are output to printer.
	ERROR THRESHOLD	The following two kinds of threshold can be set by switching printer output selection switch H on the rear panel. (1) error rate threshold (2) error count threshold [SET ≫] When the SET key is pressed, the error performance parameter display changes to the error threshold display. At this time, threshold cannot be changed by using the [∧] or [∨] key.

Table 3-3 (Cont.)

No.	Indication	Description
R-13	(ERROR RATE THRESHOLD)	When the SET key is pressed again, the value on the left blinks. During this state, threshold can be changed by using the [⩔] or [⩓] key. When the SET key is pressed again, the blinking stops. Threshold is set in either of these two states.
	(ERROR COUNT THRESHOLD)	When error threshold is the error count threshold, and the SET key is pressed again, the most significant digit of the six digits blinks. During this blinking state, threshold can be changed by using the [⩔] or [⩓] key. When the SET is pressed again, the blinking sequentially shifts from the most significant digit to the least digit. The blinking digit and the high-order digit can be changed by using the [⩔] or [⩓] key. Refer to paragraph 3.4.13 for Details on error threshold modification.
	[ERROR MODE]	° BIT : Bit error detection by binary signal level. The CMI, AMI and HDB3 code signals are converted to binary signal level by a decoder. Bit errors are detected by a closed loop. ° CODE: Detection of the following code errors: (AMI) ... Bipolar rule violation. When positive polarity or negative polarity pulses are generated consecutively for two or more bits, the pulses after the first pulse are code errors.

Table 3-3 (Cont.)

No.	Indication	Description
R-13	[ERROR MODE] (cont.)	(HDB3) .. This error occurs when two or more consecutive violation bits are generated at the same polarity. The pulses after the first bit are code errors.
		(CMI) ... (CMI data consist of full and half bits. A binary level 1 signal corresponds to a full bit and binary level 0 signal corresponds to a half bit.) This error occurs when two or more consecutive full bits are generated at the same polarity. The pulses after the first bit are code errors.
		° BLOCK: In PRBS only, PRBS can be set by R-6. One PRBS sequence (ex. 32,767 bits for $2^{15} - 1$) is considered to be one block. If one or more error bits are detected in one block, one block error is assumed.
	[SYNC]	[AUTO]: Re-synchronization is started automatically when the sync loss conditions below are satisfied. Once re-synchronization starts, it is repeated until synchronization is established.
		. Sync loss conditions (PRBS; 10,000 or more errors/ 30,000 clocks)

Table 3-3 (Cont.)

No.	Indication	Description
R-13	[ERROR MODE] (cont.)	(WORD; 1,000 or more errors/30,000 clocks) . Sync gain condition (PRBS; no errors in 32 clock periods) (Word; no errors in 32 to 512 clock periods) . [MAN]: Re-synchronization is restarted manually. Once re-synchronization starts, it is repeated until synchronization is established. Even if the SYNC loss conditions are satisfied once synchronization has been established, re-synchronization does not start before the MAN key is pressed.
R-14	JITTER	JITTER numeric display The jitter data or hit threshold value set by [DISPLAY MODE] R-15 is displayed. The jitter data display blinks in the following cases. (a) When measurements are made with the internal reference clock, the jitter display blinks for the PLL pull-in time and dc cut circuit constant time (approximately 8 s). (b) When measurements are made with the external reference clock, the jitter display blinks for the dc cut circuit constant time (approximately 15 s).

Table 3-3 (cont.)

No.	Indication	Description
R-14	JITTER (cont.)	(c) When measured result overflows: RANGE 10: ≥10.11 pp, ≥+5.09, ≤-5.09 RANGE 1: ≥1.011 pp, ≥+0.509, ≤-0.509 (a) RANGE 10/1, (b) RATE is set by the switch in R-15 as shown with the lamp.
R-15	JITTER	(a) [RANGE UI-PP]: Jitter range switching for R-14. (° RANGE 10): 10UI-PP (10UI-PP corresponds to 10 bit PP or 360° PP.) (° RANGE 1) : 1UI-PP (UI-PP is the unit interval. 1UI-PP corresponds to 1 bit PP or 360° PP.) (b) [RATE]: Display rate switching for R-14. Switches the updating period. (° SLOW) Display is possible down to the lowest jitter frequency 0.1 Hz. (However, the jitter reference clock must be external-input.) (° MED) Display is possible down to the lowest jitter frequency of 1 Hz.

Table 3-3 (Cont.)

No.	Indication	Description
R-15	JITTER (cont.)	(°FAST) Display is possible down to the lowest jitter frequency of 10 Hz. [FILTER]: Filter selection switch and lamp The normal 3 dB corner frequency by bit rate of the filters is shown as follows.

Bit rate kb/s	HP1 (Hz)	HP2 (Hz)	LP (Hz)
704	20	10 k	100 k
2048	20	18 k	100 k
8448	20	3 k	400 k
34368	100	10 k	800 k
68736	200	10 k	3.5 M
139264	200	10 k	3.5 M

The slope of all the filters is approximately 20 dB/decade.

° HP1/LP High pass filter No. 1 and low pass filter are inserted.

° HP2/LP High pass filter No.2 and low pass filter are inserted.

° LP Only a low pass filter is inserted.

° OFF No filter is inserted.

Table 3-3 (Cont.)

No.	Indication	Description
R-15	DISPLAY MODE	Four kinds of jitter data can be measured simultaneously. [JITTER UI] The jitter of the input clock or code data are measured and PP, +P, and -P, are displayed sequentially each time the key is pressed. In the CURRENT DATA mode in R-11, the current jitter are measured and displayed in accordance with RATE. [START/STOP] R-11 is unrelated to the key. In the LAST DATA mode in R-11, the maximum value of jitter measured during the gating period is displayed. See R-8 for details on the gating period. A reference clock and a clock to be measured must be input in jitter measurement. The reference clock is one of the six internal frequencies (704, 2048, 8448, 34369, 68736, 139264 kHz). The external reference clock is input through JITTER REF CLOCK R-27 on the rear panel. Measured clocks include one input by the front CLOCK INPUT (R-1), and one regenerated by the clock recovery circuit. There are two types of clock recovery circuits: a four-wave AMI HDB3 clock recovery circuit (704, 2048, 8448, and 34368 kHz), and a two-wave CMI clock recovery circuit. (68736 and 139264 kHz) [PRINT]: Used to output the Jitter UI mode to the printer R-16. When this key is pressed, the displayed jitter contents and the time are printed (option 01).

Table 3-3 (Cont.)

No.	Indication	Description
R-15	DISPLAY MODE (cont.)	[HIT COUNT] The number of jitters exceeding the value set at HIT THRESHOLD are displayed as hits. Both (+) hits and (-) hits are detected. The measuring time is the value set with GATING PERIOD R-8 and MEAS/EVALUATION R-11. This is the same as in error measurement, and the total number of hits is displayed. The display switches to exponential (0.00E00) when the number of hits exceeds 999,999. ° [HIT INTVLS]: Number of intervals (1 s, 0.1 s, 0.01 s) set with switches C, D, and E of rear panel ADDITIONAL FUNCTION R-23 at which one or more errors occurred. The display switches to exponential (0.00E00) when the number errors exceeds 999,999. The interval and hit pulses are asynchronous. ° [HIT FREE INTVLS]: Can be selected by the HIT FREE INTVLS key. HIT FREE INTVLS and HIT FREE INTVLS % are displayed alternately each time the key is pressed. HIT FREE INTVLS subtracts the number of hit intervals from the number of intervals for the gating period. This gives the hit free seconds at 1 s intervals, hit free deciseconds at 0.1 s intervals and hit free centiseconds at 0.01 s intervals. The display switches to the exponential (0.00E00) when the number of hit intervals exceeds 999,999.

Table 3-3 (Cont.)

<table>
<tr><th>No.</th><th>Indication</th><th>Description</th></tr>
<tr><td>R-15</td><td>DISPLAY MODE (cont.)</td><td>° [HIT FREE INTVLS %]: This is the ratio of the difference of the number of hit intervals subtracted from the number of intervals of the gating period to the total number of intervals; it is displayed in % units (00.000%).

When there are no hits during the measuring time, 100.000% is displayed.</td></tr>
<tr><td></td><td>HIT THRESHOLD</td><td>° [SET]: When this key is pressed, the lamp lights and the threshold value is displayed at R-14.

Use the [⩒] and [⩓] keys to make a change. The threshold related ranges of RANGE are:

<table>
<tr><th>RANGE</th><th>Threshold (UI)</th><th>Step (UI)</th></tr>
<tr><td>1</td><td>0.050 - 0.500</td><td>0.001</td></tr>
<tr><td>10</td><td>0.50 - 5.00</td><td>0.01</td></tr>
</table>
The SET lamp blinks for range and threshold relationships other than the above.

. [⩒], [⩓]: Used with the [SET] switch to set HIT THRESHOLD value.</td></tr>
<tr><td>R-16</td><td>PRINTER</td><td>A thermal printer is built in when option 01 is used.

It is a 20 column printer and prints measurement conditions, measured results, and time.

[PRINT]: When this lamp is lit, printing is possible. When not printing, turn off the lamp by re-pressing the [PRINT] switch.</td></tr>
</table>

Table 3-3 (Cont.)

No.	Indication	Description
R-16	PRINTER (cont.)	[FEED]: Printing paper feed switch. The printer head is not burned because "paper end" status is maintained even when there is no more paper. For details, see paragraph 3.4.17. ° [PRINTER EJECT]: Press to release the printer and replace the printing paper. (See paragraph 3.4.17)
R-17	[POWER] ON/OFF	Ac power switch with lamp The power-on indicator is a neon lamp and acts as the ac line primary side monitor. All LED lamps light for several seconds for lamp testing after the POWER is switched on. For safety, the power switch turns both sides of the ac line ON/OFF. AC PWR FAIL R-9 will detect power failure only when this switch is ON.
R-18	GP-IB	The ME520B has a standard GP-IB function. (For details, see SECTION 5, GP-IB INTERFACE.) ° REMOTE: When the indication lamp lights, the ME520B is controlled by the GP-IB controller. For self-testing, it is automatically placed in the remote mode. [LOCAL]: When the ME520B is other than REMOTE, the LOCAL key is effective.

Table 3-3 (Cont.)

No.	Indication	Description
R-19	PANEL LOCK	The panel lock key has the following three modes: (a) Panel-Lock All the keys except the power switch and INPUT R-7 manual threshold setting are locked. (b) Panel-Lock + lamp test A lamp test is performed in the panel lock state described in (a). All lamps light. Pressing the key again releases panel lock and cancels the lamp test. (c) Normal The Panel-Lock lamp is off and panel lock and lamp test are reset.

3.2.4 Receiver rear panel (refer to Fig. 3-4)

Table 3-4 Receiver Rear Panel Functions

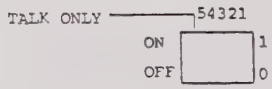
No.	Indication	Description
R-20	GP-IB	GP-IB connector Used for GP-IB operations, self-testing, and in address 0 modes.
R-21	ADDRESS  	(1) GP-IB operation Set to the controller specification address. Set the TALK-ONLY switch OFF. (2) Self-test and address 0 mode Reset all switches to zero before turning the power on. (3) TALK-ONLY mode Set the TALK ONLY switch (left-hand side) ON.
R-22	PRINTER OUTPUT SELECTION	Switches A to G (except H) are useful at SINGLE and REPEAT for R-11 MEAS/EVALUATION CURRENT DATA, and at REPEAT for LAST DATA. If printing format is set to ERROR PERFORMANCE, switches A to G will not be effective and thus will not operate. Data will be printed out in an ERROR PERFORMANCE format. The above mentioned applies, both to the built-in, and external (talk only mode) printers. Key functions are described as follows: A ON OFF ERROR PRINT Error data ON/OFF switches for printer output

Table 3-4 (Cont.)

No.	Indication		Description
R-22	PRINTER OUTPUT SELECTION (cont.)	B	ALL DISPLAYED ERROR PRINT Effective only when switch A is ON. When the input data exceed the print trigger threshold set by switches E, F, and G, it will be printed out. Switch B is 1: all error-data 10 items will be output. Switch B is 0: only one item set on the front panel will be output.
		C	ON OFF JITTER PRINT Jitter-data ON/OFF switches for printer output
		D	ALL DISPLAYED JITTER PRINT Effective only when switch C is ON. When the input data exceed the print trigger threshold set by switches E, F, and G, they will be printed out. Switch D is 1: all jitter-data seven items will be output. Switch D is 0: only one item set on the front panel will be output.
		E	%SES OFF PRINT TRIGGER (at CURRENT MODE) Switch E is 1: when input data exceed %SES threshold they will be printed out. Switch E is 0: above trigger operation is not carried out.

Table 3-4 (Cont.)

No.	Indication		Description
R-22	PRINTER OUTPUT SELECTION (cont.)	F	%DM OFF PRINT TRIGGER (at CURRENT MODE) Switch F is 1: when input data exceed %DM threshold, they will be printed out. Switch F is 0: above trigger operation is not carried out.
		G	%ES OFF PRINT TRIGGER (at CURRENT MODE) Switch G is 1: at every errored second input data will be printed out. Switch G is 0: above trigger operation is not carried out. Two or all of the switches E, F, and G can be turned ON at the same time. When the three are all on, any input data that exceed %SES, %DM, or %ES threshold will be printed out.
		H	E.RATE E.COUNT ERROR THRESHOLD Switch for ERROR PERFORMANCE parameter error threshold Switch H is 1: error rate threshold Switch H is 0: error count threshold
R-23	ADDITIONAL FUNCTION	A	ON OFF SELF TEST Self-test can be made when the R-21 address switches are all off (Address 0). For details, refer to paragraph 5.3.4 (2).

Table 3-4 (Cont.)

No.	Indication	Description
R-23	ADDITIONAL FUNCTION (cont.)	ON: Self-test is performed. If all items are operated properly, PASS will be indicated on the error-related indicator on the front panel. When an error occurs, the error description will be displayed by the Err display and will be printed out by the built-in printer. OFF: When turned to the OFF state from the ON state, self-test will be released and will be set to the initial state. B ON OFF BUZZER When it is ON, the buzzer will sound at every error. (The buzzer is effective only while measuring; the buzzer will not sound if nothing is being gated.) C 1 second D 0.1 s ERROR, HIT INTERVAL E 0.01 s Selects interval of error interval and hit interval. When switches C, D, and E are all set to 1 or 0, 1 s interval will be effective. When more than two switches are set to 1, the longer time interval will be selected. F INT EXT JITTER REF CLOCK Jitter reference clock internal/ external switch Jitter measurement with frequency other than six internal clock frequencies (704, 2048, 8448, 34368, 68736, and 139264 kHz) or low frequency range jitter measurement below 20 Hz is made by external reference clock.

Table 3-4 (Cont.)

No.	Indication	Description
R-23	ADDITIONAL FUNCTION (cont.)	External reference clock is input by R-27 JITTER REF CLOCK IN/OUT (ECL). G INT EXT JITTER MEASUREMENT Switch to determine whether to connect jitter-measurement analog signals (PD detected output signal) internally-or externally (input from R-26 JITTER MEASURE INPUT). H START NOT START WHEN JITTER-DISP BLINKS MEAS START/NOT START If jitter measurement circuit is not stabilized, the jitter indicator blinks. This switch selects whether or not to include jitter indicator blinking as a condition to start measurement. When this switch is 0 and Jitter indicator is blinking, error, or hit measurement will not begin even if the START key is pressed. Measurement will start as soon as the jitter indicator stops blinking.
R-24	-5.2 V OUT	The 139264 kb/s CMI signal residual jitter will be improved to $\leq$ 0.025UIp-p (HP1+LP, 25° ±10°C) by using the externally installed Clock Recovery MP547A. This connector -5.2 V OUT is used as the MP547A -5.2 V power supply.

Table 3-4 (Cont.)

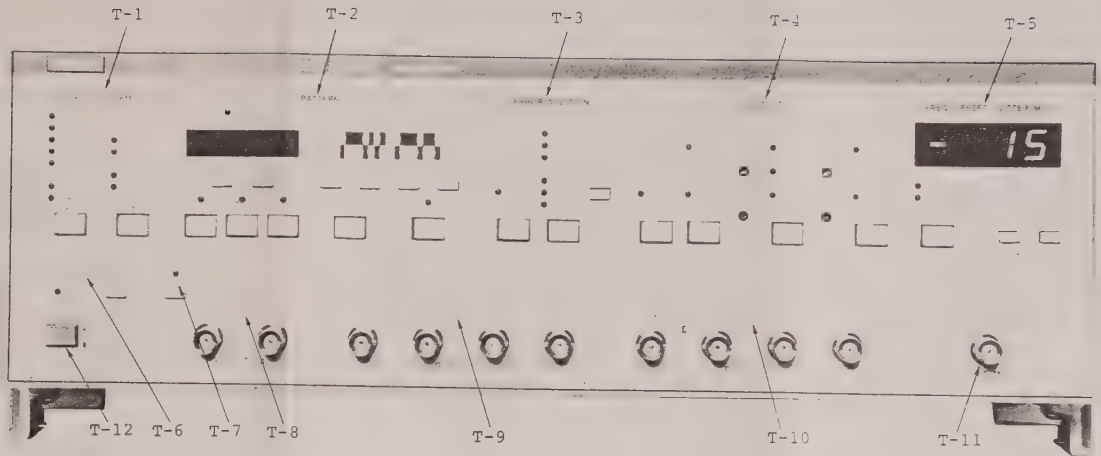
No.	Indication	Description
R-25	ERROR RATE OUTPUT RECORDER	Appropriate dc voltage in accordance with index part of error rate measurement result will be output. Dc output voltage will be renewed (increased/decreased by 0.5 V unit) after each gating is completed (refer to paragraph 3.4.15). Output impedance is of operational amplifier and is usually low.
R-26	JITTER MEASURE INPUT	This connector is used when the R-23 ADDITIONAL FUNCTION G switch is set to 0. The jitter display corresponds to the analog voltage input applied to this input connector. The input sensitivity value is 1.0 V/UI-PP for RANGE 1 and 0.1 V/UI-PP for RANGE 10. When evaluating jitter with other than a built-in filter, insert an external filter between this input and JITTER DEMOD OUTPUT R-28.
R-27	JITTER REF CLOCK IN/OUT (ECL)	This connection is used when the R-23 ADDITION FUNCTION F switch is set to EXT. When the F switch is set to 1, internal reference ECL output is selected. When the F switch is set to 0, external reference clock ECL input is selected. The ECL gate IC output is terminated with 130 Ω(G) and 180 Ω (-5.2 V). The ECL gate IC input is terminated with 130 Ω(G) and 180 Ω (-5.2V).
R-28	JITTER DEMOD OUTPUT	This is the analog signal output with the dc component of the jitter measurement phase detection output removed. The output level is 1.0 V/UI-PP for RANGE 1 and 0.1 V/UI-PP for RANGE 10. The output impedance is normally low (operational amplifier output). The dc component is $\leq$5 mV.

Table 3-4 (Cont.)

No.	Indication	Description
R-29 to R-32 (OUTPUT, ECL)		
R-29	PATTERN SYNC (ECL)	Pseudorandom and word pattern synchronization output (ECL). OUTPUT PRBS : 1 pulse/period Word length 2 to 16 bits: 1 pulse/2 periods Word length 1 bit : 1 pulse/4 bits Pulse width : Two clocks When zero substitution is added, the pulse width is expanded by that amount.
R-30	DATA, OUTPUT (ECL)	Binary NRZ (ECL) output The AMI, HDB3, and CMI signals are converted to NRZ by a decoder. The output is the ECL gate IC output.
R-31	CLOCK MONITOR OUTPUT (ECL)	For unipolar measurement, the output source is the input signal at front panel CLOCK INPUT. For AMI, HDB3, and CMI, it is the output signal of the clock recovery circuit. The output is the ECL gate output.
R-32	ERROR OUTPUT (ECL)	Error detection output RZ format The output is the ECL gate output.
R-33	NO SIGNAL OUTPUT (TTL)	The same signal as the LED which is on the right of STATUS on the front panel will be output at TTL level. When NO SIGNAL, the output will be high level.

Table 3-4 (Cont.)

No.	Indication	Description
R-34	SYNC LOSS OUTPUT (TTL)	The same signal as the LED on the right of STATUS on the front panel will be output at TTL level. When SYNC LOSS, the output will be high level.
R-35	⏚	Ground terminal
R-36	** V	Ac power inlet; connect to a three-pin ac power supply
R-37	*** A	There is one fuse on each side of the ac line. (See Note at beginning of this manual.) When replacing a fuse, be sure to unplug the power cable. Both fuses must be the same type and rating.



o: lit lamp (example)

Fig. 3-1 Transmitter Front Panel

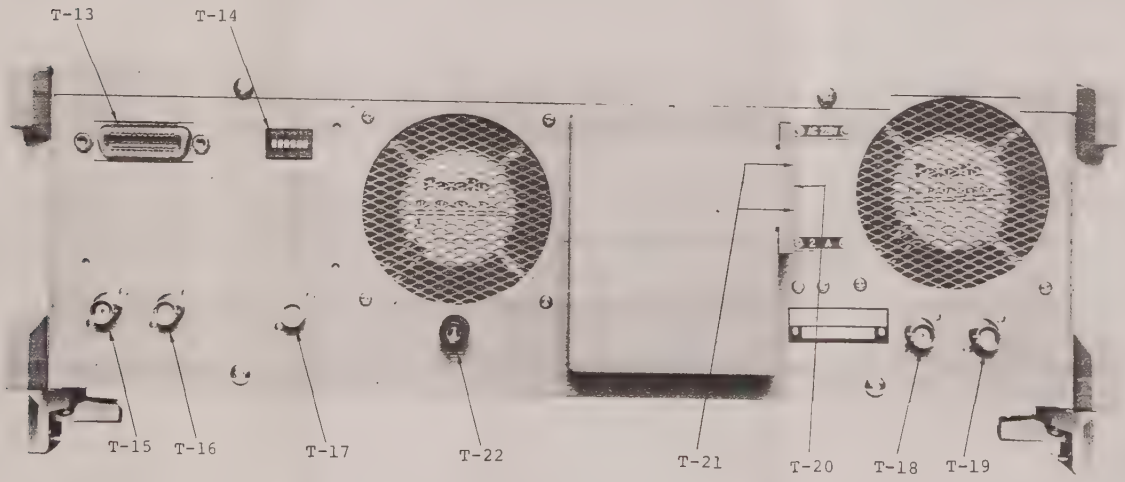
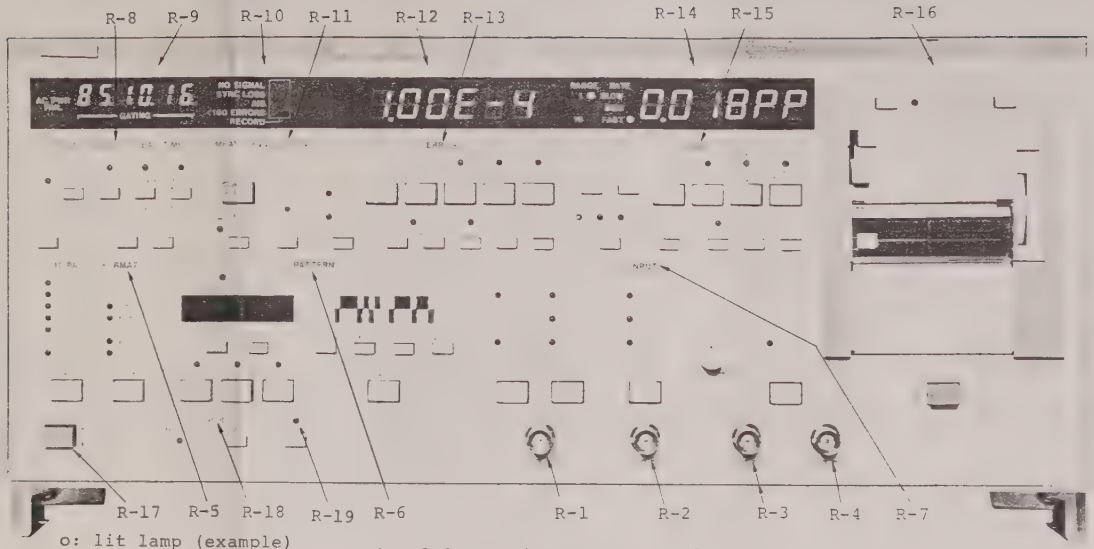


Fig. 3-2 Transmitter Rear Panel



o: lit lamp (example)

Fig. 3-3 Receiver Front Panel

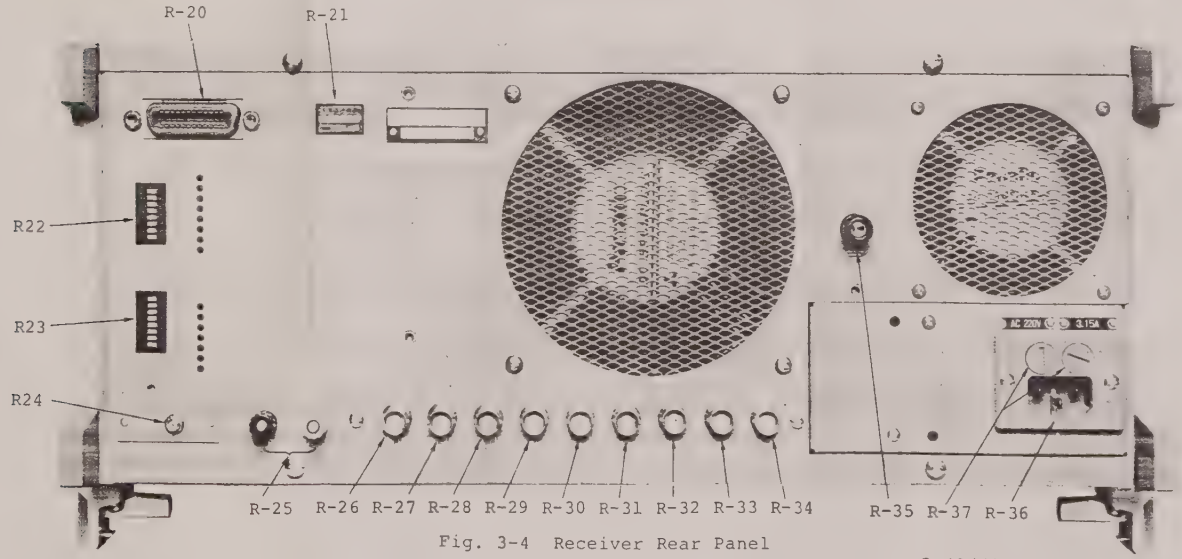


Fig. 3-4 Receiver Rear Panel

MEMO

3.2.5 Transmitter internal switches

These switches are on the Z1 CPU board under the top cover.

The levels of switches labeled "FC*" are set at the factory.

All other switches are set to OFF at the factory.

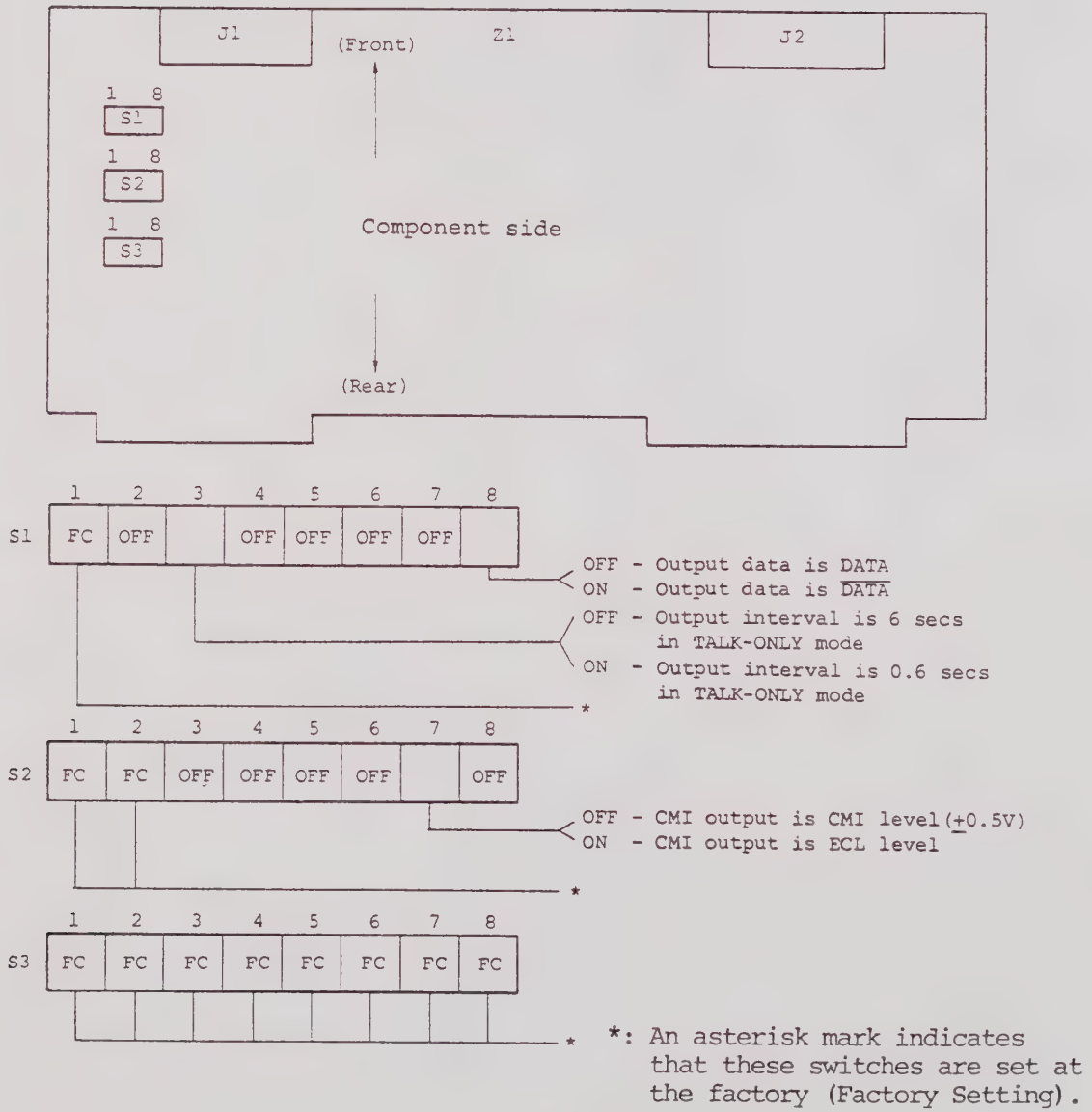

J1
(Front)
Z1
J2
1 8
S1
1 8
S2
1 8
S3
Component side
(Rear)
1 2 3 4 5 6 7 8
S1
FC OFF OFF OFF OFF OFF
OFF - Output data is DATA
ON - Output data is DATA
OFF - Output interval is 6 secs in TALK-ONLY mode
ON - Output interval is 0.6 secs in TALK-ONLY mode
*
1 2 3 4 5 6 7 8
S2
FC FC OFF OFF OFF OFF OFF
OFF - CMI output is CMI level (±0.5V)
ON - CMI output is ECL level
*
1 2 3 4 5 6 7 8
S3
FC FC FC FC FC FC FC FC
*
*: An asterisk mark indicates that these switches are set at the factory (Factory Setting).

Fig. 3-5 Transmitter Internal Switch Settings

3.2.6 Receiver internal switches

The switches are on the Z12 CPU board under the right-hand side cover.

All internal switches are set to OFF at the factory.

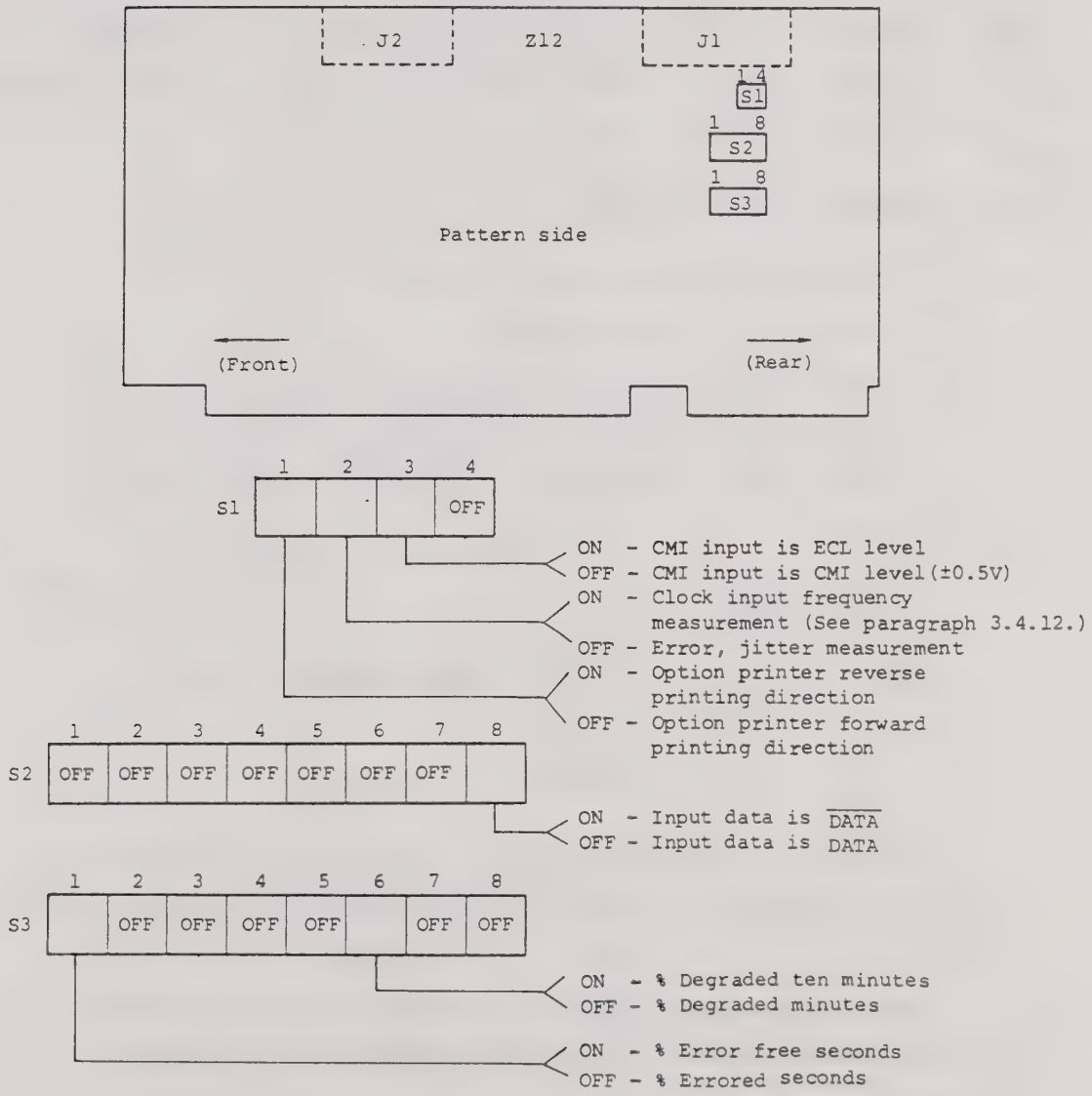


Fig. 3-6 Receiver Internal Switch Settings

Note:

Change internal switch settings only when the power is OFF or measurement is turned to STOP (when START/STOP Key lamp is not lit.)

3.2.7 Clock gating time

The ME520B clock gating period varies with the bit rate. The 10^6 to 10^{12} ranges can be set in decade steps. For the measurement period, the number of clocks is not counted accurately using counters. The measurement is performed by calculating the gating time and converting it to the time in 0.1 s steps that is greater than and nearest to the former.

(Gating time calculation)

$$GTo = \frac{1}{f} \times \text{Gating Period (calculated value)}$$

$GT \geqq GTo$ (GT is in 0.1-second steps.)

f: Input frequency at measurement start

GTo: Gating time calculated value

GT: Final measurement period (in 0.1-second steps)

Example

[$f = 139.264$ MHz, Gating Period = 10^9]

$$GTo = \frac{1}{139.264 \times 10^6} \times 10^9 = 7.1806 \text{ (Seconds)}$$

GT = 7.2 (Seconds)

Therefore, the measurement period is 7.2 seconds in the above example and the number of final clocks is 1.00270×10^9.

The ratio of GT to GTo (GT/GTo) is listed below according to each bit rate and preset gating period.

Table 3-5 Ratio of the Measurement Period and the Gating Time Calculated Value

Bit Rate (kb/s)	Gating Period 1E06 10^6	1E07 10^7	1E08 10^8	1E09 10^9	1E10 10^{10}	1E11 10^{11}	1E12 10^{12}
704	1.05600	1.00672	1.00038	1.00003	1.00000	1.00000	1.00000
2048	——	1.00352	1.00147	1.00003	1.00001	1.00000	1.00000
8448	——	1.01376	1.00531	1.00024	1.00007	1.00000	1.00000
34368	——	——	1.03104	1.00010	1.00010	1.00000	1.00000
68736	——	——	1.03104	1.00354	1.00010	1.00004	1.00000
139264	——	——	——	1.00270	1.00130	1.00005	1.00001

* GT : GTo ratio display

When the CLOCK key is pressed after the measurement is started, the GT : GTo ratio is displayed instead of the set value.

When the CLOCK key is pressed again, the set value is displayed.

Example 34.368 MHz, 10^8

Display

[START] ----- 1E08
↓ ↓
[CLOCK] ----- 1.03104
↓ ↓
[CLOCK] ----- 1E08
↓ ↓
[CLOCK] ----- 1.03104

The accurate final gating period value can be read by combining both numeric characters of the set value (exponent) and the GT : GTo ratio (mantissa). In the above example, 1.03104×10^8 is obtained.

3.3 Measurement Preparations

3.3.1 Installation site environment conditions

The ME520B will operate normally in an ambient temperature of 0° to 50°C. Do not use it in places:

(1) where vibrations are severe.

(2) where it is damp or dusty.

(3) where there is exposure to direct sunlight.

For dependable operation over a long period of time, the ME520B should be used at 5° to 30°C.

3.3.2 Power line voltage

The ME520B operates on ** Vac (max. 250 V) power.

Before connecting the instrument to a power source, be sure to check the source voltage.

3.3.3 Connection to power source

After ensuring that the POWER switch is OFF, connect the instrument to the power source using the accessory power cord.

3.3.4 Self-testing

Refer to the self-testing explanation in paragraph 5.3.4 (2).

3.3.5 Built-in battery (for memory back up)

A battery is mounted on the ME520B transmitter Z1 CPU, and receiver Z12 CPU, PC boards. All preset information and final measurement results are stored even if the ac power is turned off. The battery is a lithium thionyl chloride primary cell.

CAUTION

The battery output impedance is very low; be extremely carefully not to short-circuit the ⊕ and ⊖ terminals.

Backup Period

If a new battery is used, the backup time is approximately six years assuming that the average use is three hours per day.

CAUTION

Never try to recharge the battery because it is a primary cell.

3.4 Measurement

Note:

If power-down/recovery occurs during a measurement the displayed result will be incorrect unless the timing is as shown in Fig. 3-7.

Turn the ac POWER switches on the receiver and transmitter OFF once and then ON again. Then continue the measurement.

GATING: MANUAL, EC DISPLAY, CURRENT MODE

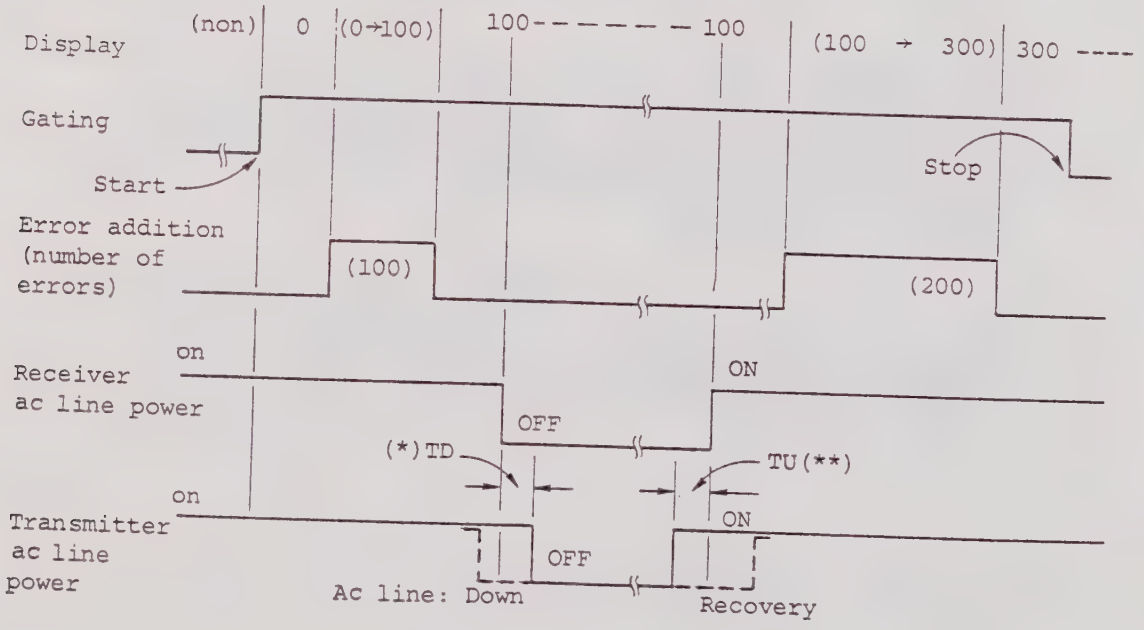


Fig. 3-7 Ac Power-Down/Recovery Timing for Correct Measurement Results

If the OFF time area of the transmitter ac line power overlaps the ON time area of the receiver ac line power (in dashed line example: TD(*)<0 or TU(**)<0 in Fig. 3-7 by lead or lag time ON ac line power of the transmitter compared with the receiver), the displayed value is incorrect (EC count exceeds number of errors).

3.4.1 AMI, HDB3 bit error measurement (PRBS pattern)

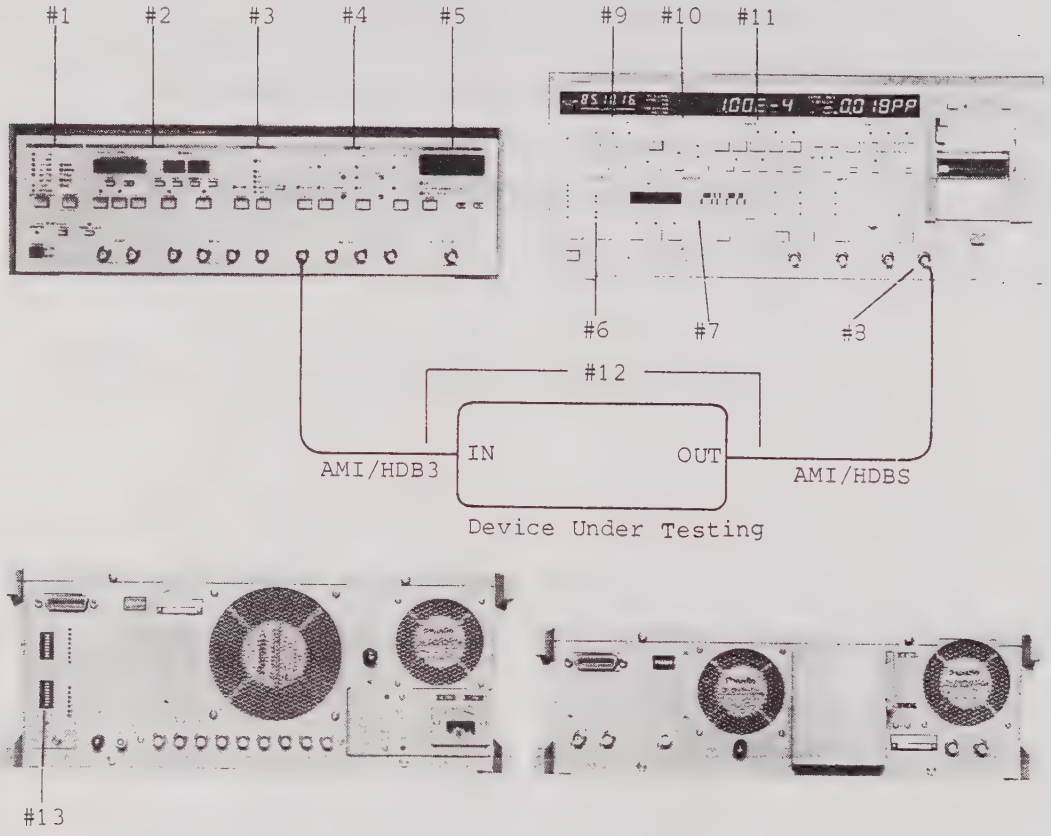


Fig. 3-8 AMI, HDB3 Bit Error Measurement

Step	Procedure
(Transmitter)	
#1.	Set [BIT RATE] to 704, 2048, 8448, or 34368 kb/s. Set [FORMAT] to AMI or HDB3.
#2.	Set PATTERN to PRBS [2^{15}-1] or [2^{23}-1]. When zero substitution is necessary, use the [⩓] key.

(cont.)

Step	Procedure
#3	Set ERROR ADDITION to BIT using the [MODE] switch, and OFF using the [RATE] switch.
#4	Set OUTPUT LEVEL to 2.37 V for 8448 kb/s or less, and to 1 V for 34368 kb/s.
#5	Set FREQ OFFSET/JITTER MOD to normal OFF using the [MODE] switch.
(Receiver)	
#6	Set BIT RATE using [RECOVERY] to the same value as the transmitter.
	Set [FORMAT] to the same value as the transmitter.
#7	Set PATTERN to the same value as the transmitter.
#8	Set INPUT to TERM using the [MODE] switch.
#9	Set GATING PERIOD to [TIME], [CLOCK], or [MAN]. For TIME and CLOCK, use the [⩒] and [⩓] keys to set the necessary period.
#10	MEAS/EVALUATION
	Select SINGLE or REPEAT.
	Select LAST DATA or CURRENT DATA, depending upon the measurement.
#11	Set ERROR MODE to BIT.
	Set SYNC to AUTO.
	Select one of the four display modes under DISPLAY MODE.

(cont.)

Step	Procedure
#12.	Connect the input and output coaxial cables as shown in Fig. 3-8.
#13.	Set ADDITIONAL FUNCTION as follows:

(Mark)	(Set)	(Item and Contents)	
A	0	SELF TEST:	OFF
B	1/0	BUZZER:	ON or OFF
C*	1/0	1 s	ERROR, HIT INTERVAL: Set one of C, D or E to "1"
D*	1/0	0.1 s	
E*	1/0	0.01 s	
F	1	JITTER REF CLOCK:	INT
G	1	JITTER MEASUREMENT:	INT
H	1	WHEN JITTER-DISP BLINKS MEAS START/NOT START	

Measurement starts when the [START/STOP] key is pressed; measurement cannot start if a receiver BIT RATE LED (R-5) is blinking. If one is blinking, check the I/O signals.

If jitter parameters are changed, the measurement cycle is interrupted.

3.4.2 CMI bit error measurement (Word pattern)

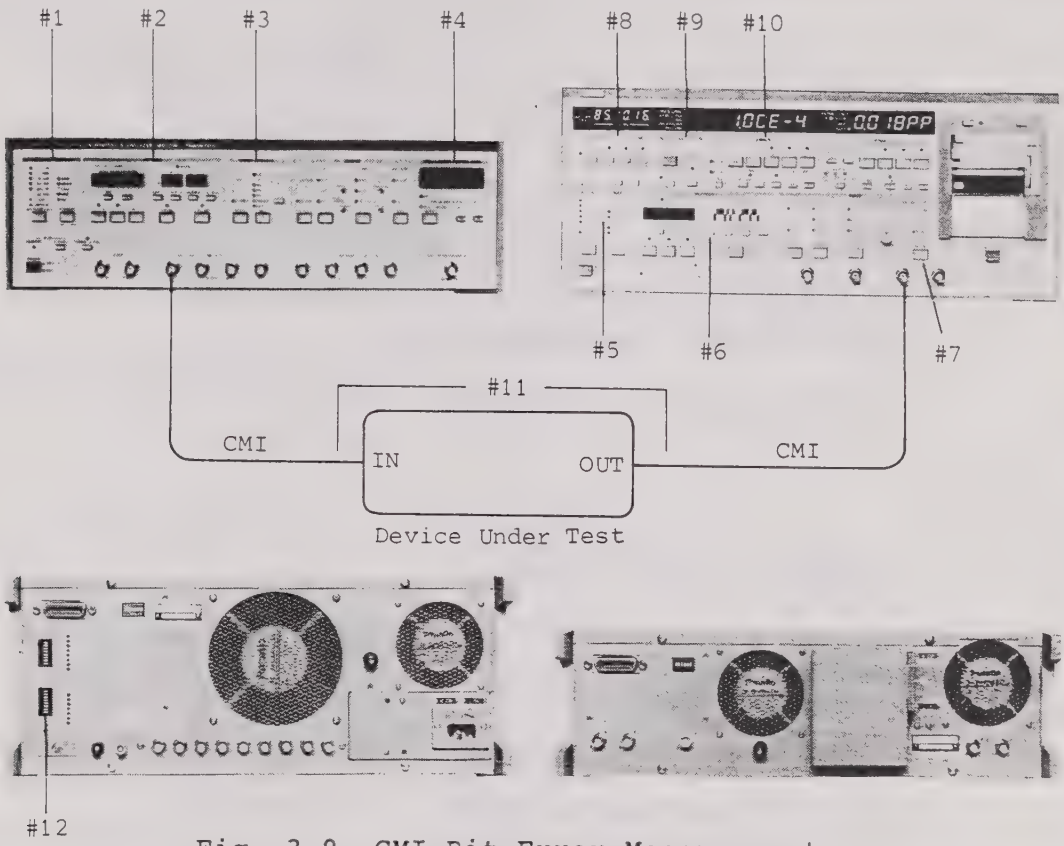


Fig. 3-9 CMI Bit Error Measurement

Step	Procedure
(Transmitter)	
#1.	Set [BIT RATE] to 68736 or 139264 kb/s. Set [FORMAT] to CMI.
#2.	Set PATTERN to [1-16 BIT]. Press the [CLEAR] key to clear the previous word pattern. Use the [SET 1] and [SET 0] keys to sequentially set the necessary number of bits.

(cont.)

Step	Procedure
	When modifying a set pattern, press the [MODIFY] key to move the blinking LED position to the bit position to be modified. Then use the [SET 1] or [SET 0] key to modify that position. The LED of the modified bit will continue to blink. To stop the blinking, press the [MODIFY] key and move the blinking position toward the right.
#3	Set ERROR ADDITION to BIT using the [MODE] switch, and OFF using the [RATE] switch.
#4	Set FREQ OFFSET/JITTER MOD to OFF using the [MODE] switch.
(Receiver)	
#5	Set BIT RATE using [RECOVERY] to the same value as the transmitter.
	Set [FORMAT] to CMI.
#6	Set PATTERN to [1-16 BIT].
	Set the same word pattern as the transmitter.
#7	Set INPUT to TERM using the [MODE] switch.
#8	Set GATING PERIOD to [TIME], [CLOCK], or [MAN].
	For TIME and CLOCK, set the necessary period using the [⩔] and [⩓] keys.
#9	MEAS/EVALUATION
	Select SINGLE or REPEAT measurement.
	Select LAST DATA or CURRENT DATA, depending upon the measurement to be done.

(cont.)

Step	Procedure
#10	ERROR Set ERROR MODE to BIT. Set SYNC to AUTO. Select one of the four display modes under DISPLAY MODE.
#11	Connect the input and output coaxial cables as shown in Fig. 3-9.
#12	Set ADDITIONAL FUNCTION as follows:

(Mark)	(Set)		(Item and Contents)	
A	0		SELF TEST:	OFF
B	1/0		BUZZER:	ON or OFF
C*	1/0	1 s	ERROR, HIT INTERVAL: Set one of C, D or E to "1".	
D*	1/0	0.1 s		
E*	1/0	0.01 s		
			F 1 JITTER REF CLOCK:	INT
			G 1 JITTER MEASUREMENT:	INT
H	1		WHEN JITTER-DISP BLINKS MEAS START/NOT START	

Measurement starts when the [START/STOP] key is pressed. Measurement cannot start if a receiver BIT RAT LED (R-5) is blinking; if one is blinking, check the I/O signals.

If jitter parameters are changed, the measurement cycle will be interrupted.

3.4.3 NRZ, RZ bit error measurement (PRBS pattern)

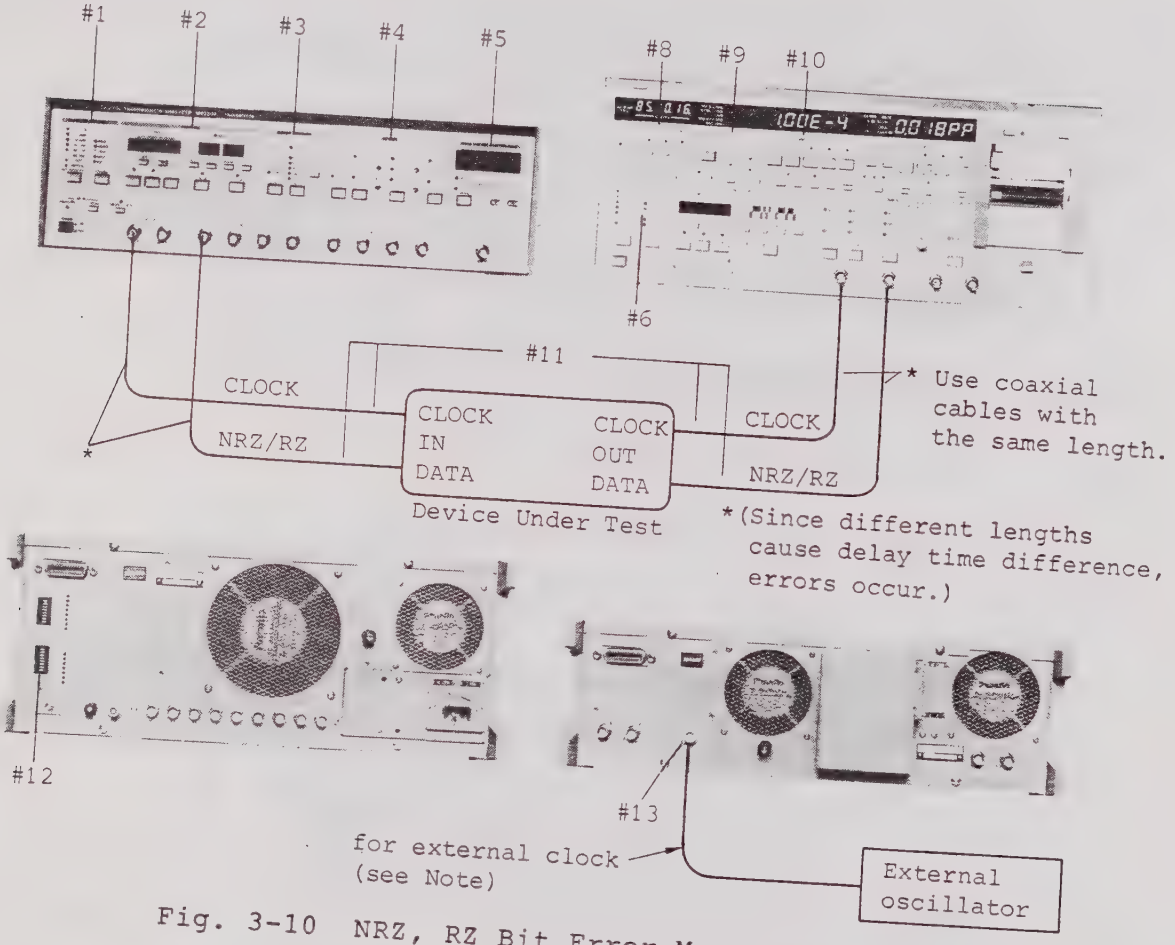


Fig. 3-10 NRZ, RZ Bit Error Measurement

Step	Procedure
(Transmitter)	
#1	Set [BIT RATE] to one of the bit rates. (See Note.) Set [FORMAT] to NRZ or RZ.
#2	Set PATTERN to PRBS [2^{10}-1], [2^{15}-1], or [2^{23}-1]. When zero addition is necessary, set it with the [⩓] key.

(cont.)

Step	Procedure
#3	Set ERROR ADDITION to BIT using the [MODE] switch, and to OFF using the [RATE] switch.
#4	o CLOCK output setting Normally, [POLARITY] is set to CLOCK. (When the timing is shifted 180°, set to $\overline{\text{CLOCK}}$.) Set the output level to TTL, ECL, or SET using [LEVEL]. When set to SET with [LEVEL], adjust AMPLITUDE and OFFSET to the desired level while monitoring the level with an oscilloscope. o NRZ/RZ output setting Set the interface of the device under test in the same way as that of CLOCK above.
#5	Normally, set FREQ OFFSET/JITTER to OFF using [MODE].
(Receiver)	
#6	Set [RECOVERY] to the same value as the transmitter setting. Set [FORMAT] to the same value as the transmitter setting.
#7	o CLOCK input setting Normally, [POLARITY] is set to CLOCK. (When the timing is shifted 180°, set to $\overline{\text{CLOCK}}$.) Set [THRESHOLD/TERM] to AUTO/GND or ECL/-2V according to the interface of the device under test. (For TTL output, set to AUTO/GND input.) o NRZ/RZ input setting Select NRZ, RZ [THRESHOLD/TERM] to MAN/GND, GND/GND, or ECL/-2 V according to the interface of the device under test. (For TTL output, set to MAN/GND input and set the knob to +1.3 V.)
#8	Set GATING PERIOD to [TIME], [CLOCK], or [MAN]. For TIME and CLOCK, set the necessary period using the [⩔] and [⩓] keys.

(cont.)

Step	Procedure
#9	MEAS/EVALUATION Select SINGLE or REPEAT measurement. Select LAST DATA or CURRENT DATA depending upon the kind of measurement to be done.
#10	ERROR Set ERROR MODE to BIT. Set SYNC to AUTO. Select one of the four display modes under DISPLAY MODE (R-13).
#11	Connect the input and output coaxial cables as shown in Fig. 3-10.
#12.	Set ADDITIONAL FUNCTION as follows:

(Mark)	(Set)		(Item and Contents)	
A	0		SELF TEST:	OFF
B	1/0		BUZZER:	ON or OFF
C*	1/0	1 s	ERROR, HIT INTERVAL: Set one of C, D or E to "1".	
D*	1/0	0.1 s		
E*	1/0	0.01 s		
F	1		JITTER REF CLOCK:	INT
G	1		JITTER MEASUREMENT:	INT
H	1		WHEN JITTER-DISP BLINKS MEAS START/NOT START	

#13.	Connect an external oscillator as shown in Fig. 3-10. (See Note).

Measurement starts when the [START/STOP] key is pressed.

Measurement cannot start if the receiver BIT RATE LED: EXT (in R-5) is blinking. If one is blinking, check the clock system signals.

If jitter parameters are changed, the measurement cycle is interrupted.

Notes:

1. When operating the instrument under control of an external clock, make the rear panel connections shown in Fig. 3-10 and set transmitter BIT RATE to EXT. (When using the internal clock, do not connect an external oscillator to the instrument.)

2. External clock duty factor:

   The duty factor is automatically compensated for a sine wave greater than 1 MHz, but sometimes the clock duty factor does not reach 50%. In such cases, remove the transmitter top cover and adjust R349 of Z2 with a screw driver. It must be adjusted when the ambient temperature or external clock frequency changes.

For rectangular waves especially less than 1 MHz, compensation of the duty factor is negligible.

When using the ME520B for low frequencies, set the external clock band selection switch S1 of Z2 to [1 kHz to 1 MHz/ RECTANGULAR].

The output duty factor is nearly the same as the input rectangular wave.

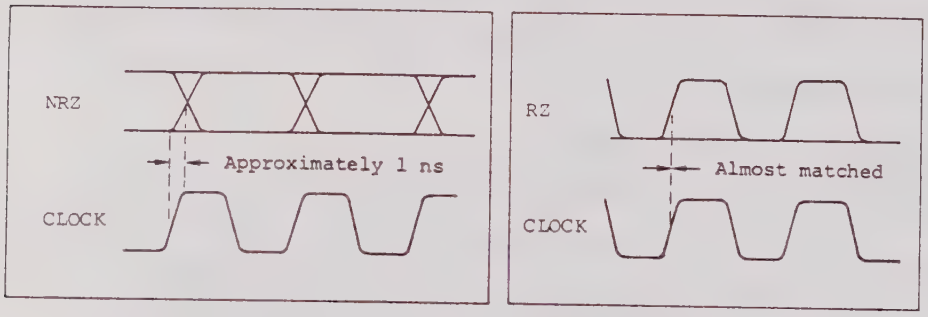
If a frequency less than 1 MHz is input when the selection switch S1 is set to [>1 MHz], an error may be generated.

DATA and CLOCK timing

(1) As shown below, the NRZ and CLOCK timing of the transmitter vary slightly with the four output connectors.

The NRZ data are delayed by approximately 1 ns.

(2) The RZ and CLOCK timing of the transmitter vary slightly with the four output connectors, but they are virtually the same.



(3) The receiver is adjusted so that it receives the above two data types and measures correctly.

Figures 3-29 and 3-30 at the end of this section 3 show the ME520B Receiver NRZ INPUT Static Phase Tolerance (typical data) and RZ INPUT Static Phase Tolerance (typical data), respectively.

3.4.4 Status

During measurement, eight LEDs show the STATUS in R-10. The explanation below refers to Fig. 3-11.

(1) Status Live (right-hand side four LEDs)

LIVE monitor. Displays the current status. The status is the same as LAST DATA or CURRENT DATA modes.

(2) Status RECORD (left-hand side four LEDs)

Records the status from the start to the present, excluding <100 ERRORS in CURRENT DATA mode.

(a) CURRENT DATA mode

Records the status from the beginning of the gating period to the current point.

(b) LAST DATA mode

Records the status at the preceding gating period (before starting for T11 to T14, gating period 1 for T21 to T23, and gating period 2 for T31).

Note:

When NO SIGNAL and SYNC LOSS occur simultaneously, NO SIGNAL (T11) masks SYNC LOSS.

When NO SIGNAL and AIS occur simultaneously, NO SIGNAL masks AIS.

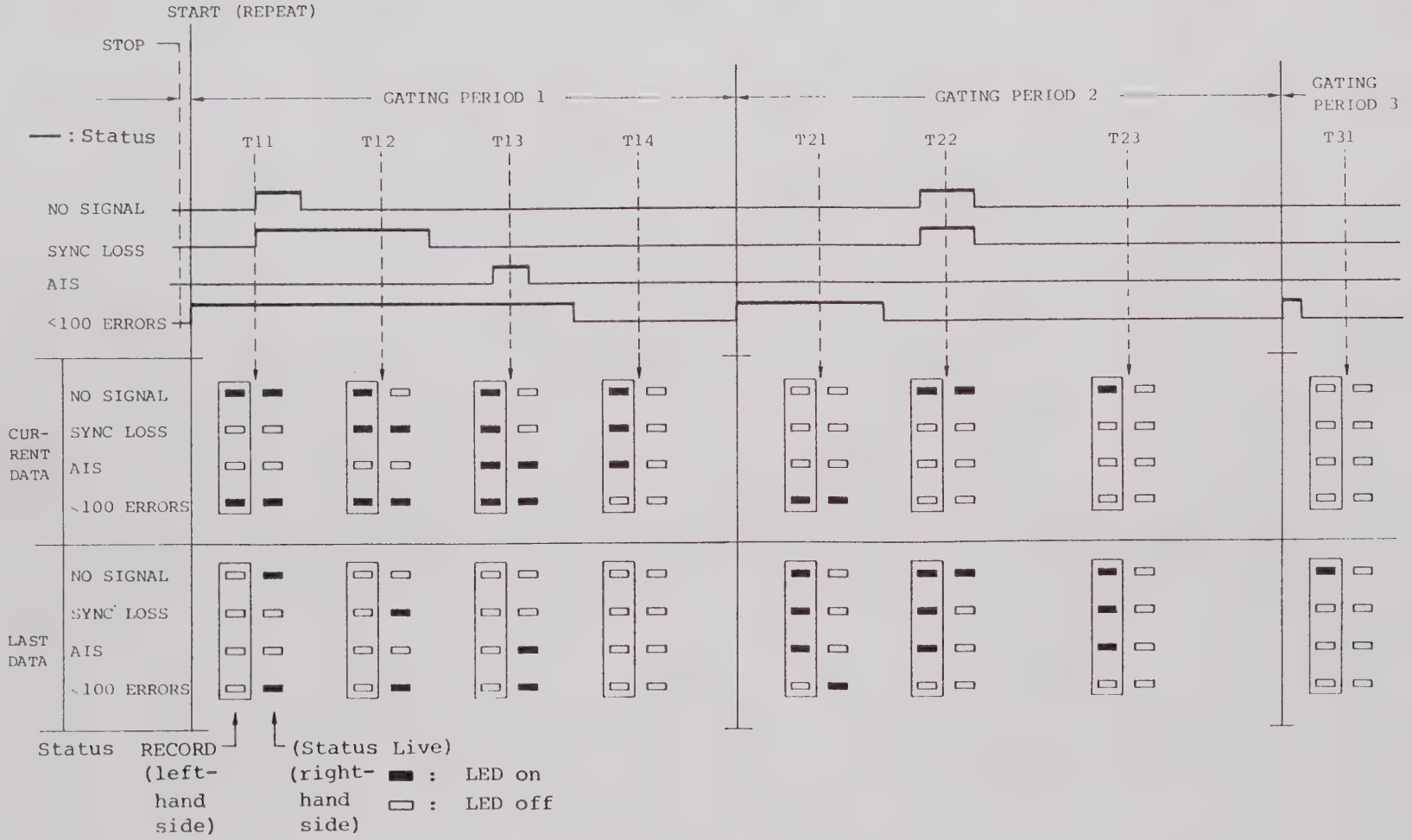


Fig. 3-11 STATUS Time Chart

3.4.5 AMI, HDB3 jitter measurement (internal reference frequency)

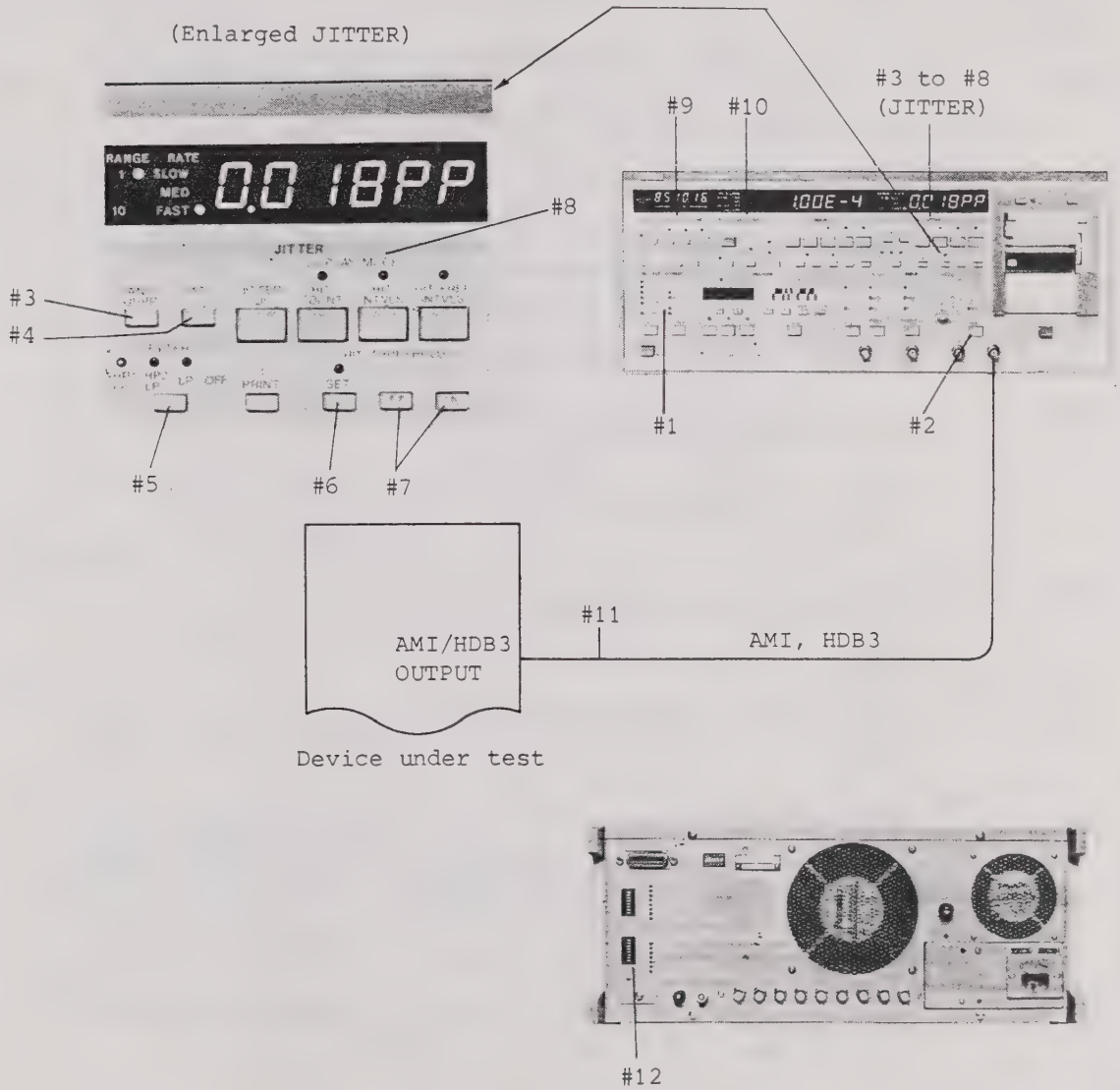


Fig. 3-12 AMI, HDB3 Jitter Measurement

Note:

Use an external reference clock when jitter is measured with AMI/HDB3 formats and bit rates except the 704, 2048, 8448, and 34368 kb/s (see paragraph 3.4.11).

Step	Procedure
(Receiver only)	
#1	Set [RECOVERY] to 704, 2048, 8448, or 34368 kb/s.
	Set [FORMAT] to AMI or HDB3.
#2	Set INPUT to TERM using [MODE] switch.
	When measuring jitter at the protect monitor terminal (actual line monitoring), set to MON.
#3	Set [RANGE UI-PP] to RANGE 1 or RANGE 10 according to the jitter value rate of the device under test.
#4	Set [RATE] to MED or FAST according to the jitter low range frequency.
	Jitter frequency <20 Hz must be measured using an external reference. (See paragraph 3.4.11.)
#5	Set FILTER to HP1/LP, HP2/LP, LP, or OFF according to the jitter evaluation region.
#6	Press the [SET] key.
#7	Set the HIT THRESHOLD using the [⩔] and [⩓] keys.
#8	DISPLAY MODE
	Select one from [JITTER UI], [HIT COUNT], [HIT INTVLS], or [HIT FREE INTVLS].
#9	Set GATING PERIOD to [TIME], [CLOCK], or [MAN].
	For [TIME] and [CLOCK], set the necessary period using the [⩔] and [⩓] keys.
#10	MEAS/EVALUATION
	Select SINGLE or REPEAT measurement.
	Select LAST DATA or CURRENT DATA, depending upon the measurement to be done.

(cont.)

Step	Procedure
#11	Connect the coaxial cable as shown in Fig. 3-12.
#12	Set ADDITIONAL FUNCTION as follows:

(Mark)	(Set)	(Item and Contents)
A	0	SELF TEST: OFF
B	1/0	BUZZER: ON or OFF
C*	1/0 1 s	ERROR, HIT INTERVAL: Set one of C, D or E to "1".
D*	1/0 0.1 s	
E*	1/0 0.01 s	
F	1	JITTER REF CLOCK: INT
G	1	JITTER MEASUREMENT: INT
H	0	WHEN JITTER-DISP BLINKS MEAS START/NOT START

Measurement is only possible when the jitter display stops blinking.

Measurement actually starts when the [START/STOP] key is pressed.

Measurement cannot start if a receiver BIT RATE LED (R-5) is blinking; if one is blinking, check the I/O signals.

3.4.6 CMI jitter measurement (internal reference frequency)

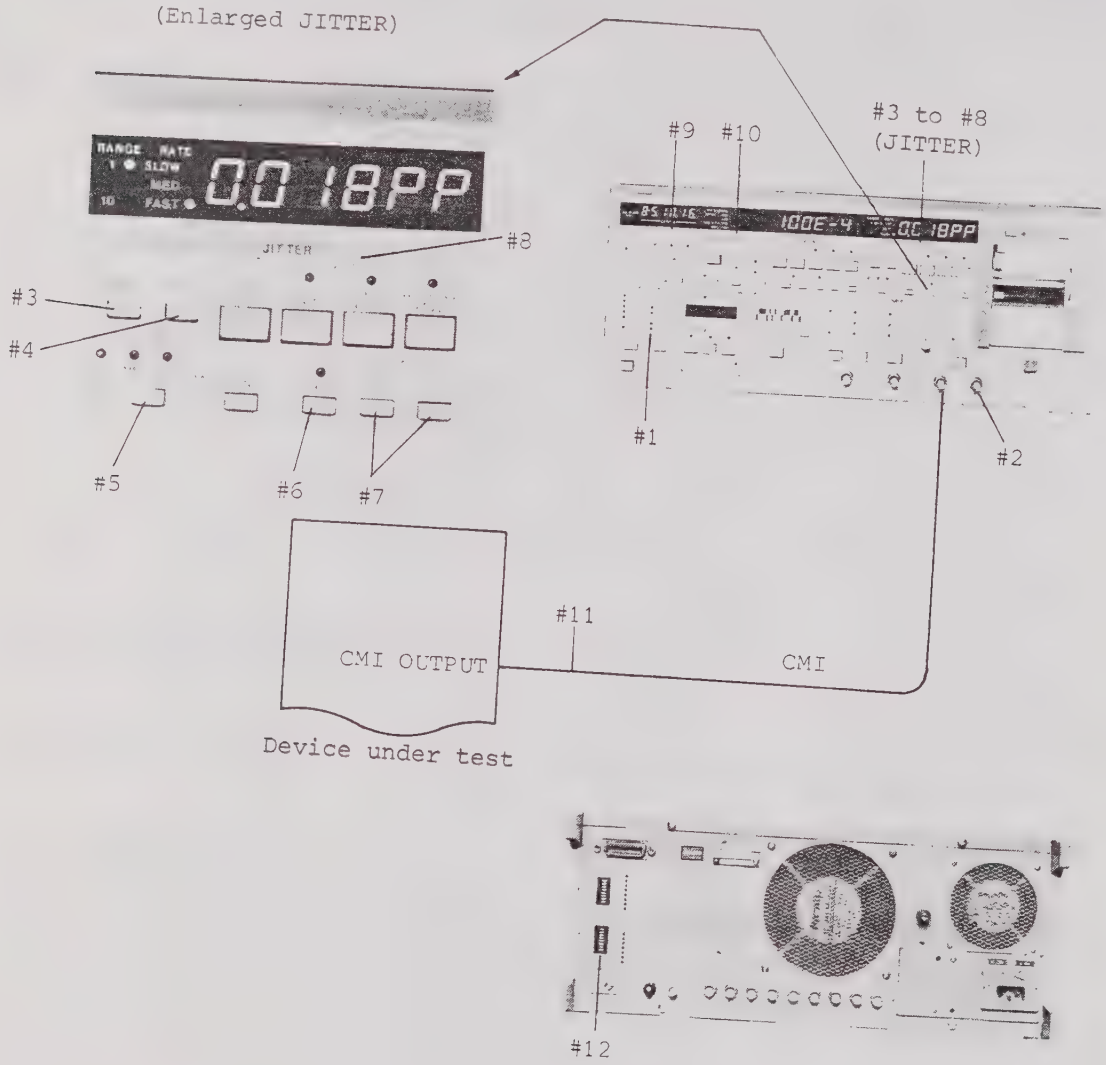


Fig. 3-13 CMI Jitter Measurement

Note:

1. Use the external reference clock for jitter measurement at bit rates other than 68736 or 139264 kb/s.

Note (cont.):

2. When measuring the 139264 kb/s CMI jitter, use the MP547A referred to in paragraph 3.4.14 for a measurement with little residual jitter.

Step	Procedure
(Receiver only)	
#1	Set [RECOVERY] to 68736 or 139264 kb/s. Set [FORMAT] to CMI.
#2	Set INPUT to TERM using [MODE] switch. When measuring the jitter at the protect monitor terminal (actual line monitoring), set to MON.
#3	Set [RANGE UI-PP] to RANGE 1 or to 10 according to the jitter of the device under test.
#4	Set [RATE] to MED or FAST according to the jitter low range frequency. Jitter frequency <20 Hz must be measured by using an external reference. (See paragraph 3.4.11.)
#5	Set FILTER to HP1/LP, HP2/LP, LP, or OFF according to the jitter evaluation range.
#6	Press the [SET] key.
#7	Set the HIT THRESHOLD using the [⩔] and [⩓] keys.
#8	DISPLAY MODE Select one from [JITTER UI], [HIT COUNT], [HIT INTVLS], or [HIT FREE INTVLS].

(cont.)

Step	Procedure
#9	Set GATING PERIOD to [TIME], [CLOCK], or [MAN]. For TIME and CLOCK, set the necessary period using the [⩒] and [⩓] keys.
#10	MEAS/EVALUATION Select SINGLE or REPEAT measurement. Select LAST DATA or CURRENT DATA, depending upon the measurement to be done.
#11	Connect the coaxial cable as shown in Fig. 3-13.
#12	Set ADDITIONAL FUNCTION as follows:

(Mark)	(Set)		(Item and Contents)
A	0		SELF TEST: OFF
B	1/0		BUZZER: ON or OFF
C*	1/0	1 s	ERROR, HIT INTERVAL: Set one of C, D or E to "1".
D*	1/0	0.1 s	
E*	1/0	0.01 s	
F	1		JITTER REF CLOCK: INT
G	1		JITTER MEASUREMENT: INT
H	0		WHEN JITTER-DISP BLINKS MEAS START/NOT START

Measurement is only possible once the jitter display stops blinking. Measurement actually starts when the [START/STOP] key is pressed.

Measurement cannot start if a receiver BIT RATE LED (R-5) is blinking; if one is blinking, check the I/O signals.

3.4.7 Clock jitter measurement (internal reference frequency)

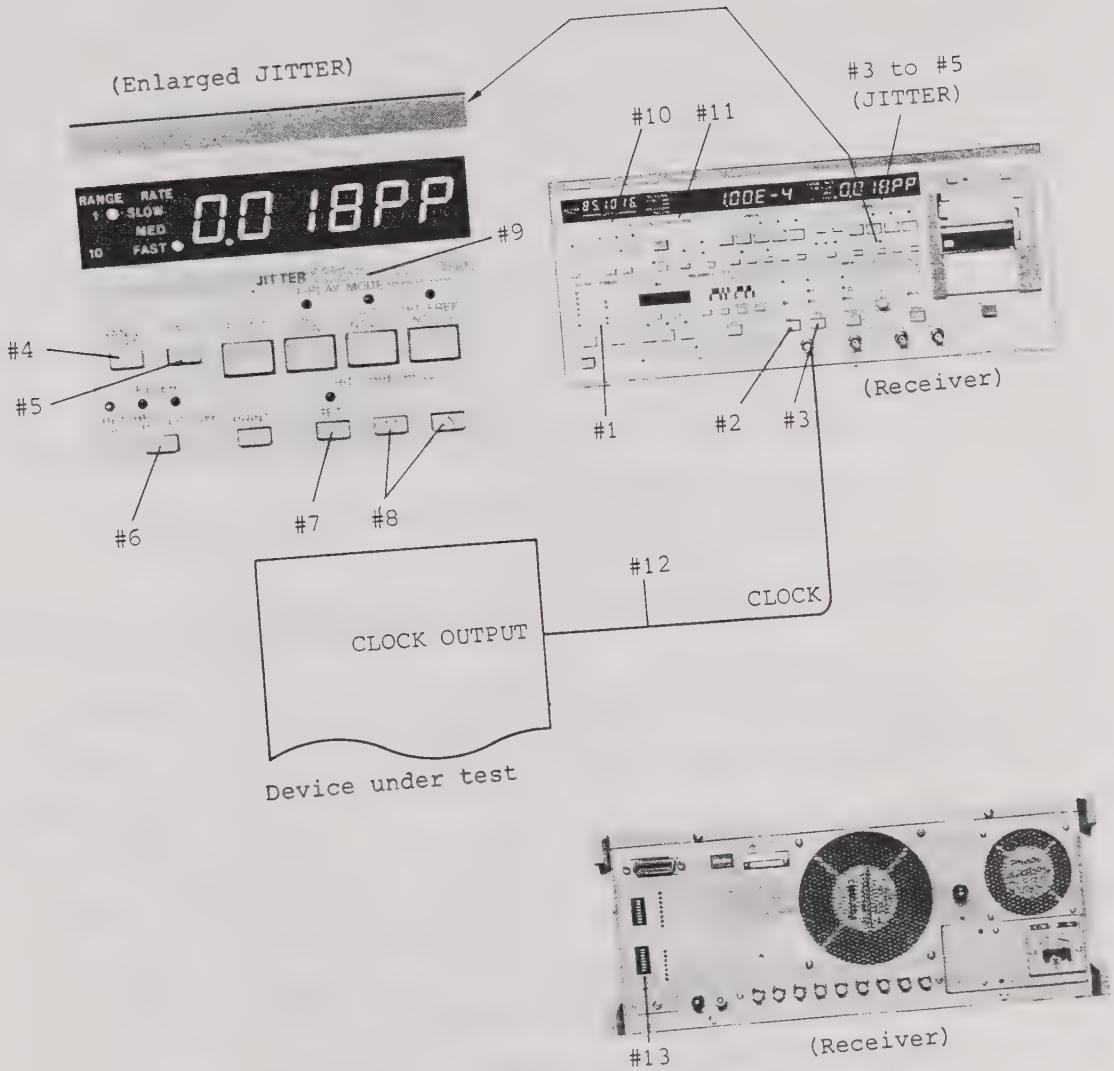


Fig. 3-14 Clock Jitter Measurement

Note:

Use an external reference clock when jitter is measured on the frequency except for the frequencies 704, 2048, 8448, 34368, 68736, and 139264 kHz (see paragraph 3.4.11).

Step	Procedure
(Receiver only)	
#1	Set [RECOVERY] to EXT. Set [FORMAT] to NRZ or RZ.
#2	INPUT (#2 to #3) Set [POLARITY] to CLOCK or $\overline{\text{CLOCK}}$.
#3	Set [THRESHOLD/TERM] to match the interface of the device under test.
#4	Set [RANGE UI-PP] to RANGE 1 or RANGE 10 according to the jitter of the device under test.
#5	Set [RATE] to MED or FAST according to the jitter low range frequency. Jitter frequency <20 Hz must be measured by using an external reference. (See Section 3.4.11.)
#6	Set FILTER to HP1/LP, HP2/LP, LP, or OFF according to the jitter evaluation range.
#7	Press the [SET] key.
#8	Set the HIT THRESHOLD using the [⩔] and [⩓] keys.
#9	DISPLAY MODE Select one from [JITTER UI], [HIT COUNT], [HIT INTVLS], or [HIT FREE INTVLS].
#10	Set GATING PERIOD to [TIME], [CLOCK] or [MAN]. For TIME and CLOCK, set the necessary time using the [⩔] and [⩓] keys.
#11	MEAS/EVALUATION Select SINGLE or REPEAT measurement. Select LAST DATA or CURRENT DATA depending upon the measurement to be done.

(cont.)

Step	Procedure
#12	Connect the coaxial cable as shown in Fig. 3-14.
#13.	Set ADDITIONAL FUNCTION as follows:

(Mark)	(Set)	(Item and Contents)
A	0	SELF TEST: OFF
B	1/0	BUZZER: ON or OFF
C*	1/0, 1 s	ERROR, HIT INTERVAL: Set one of C, D or E to "1".
D*	1/0, 0.1 s	
E*	1/0, 0.01 s	
F	1	JITTER REF CLOCK: INT
G	1	JITTER MEASUREMENT: INT
H	0	WHEN JITTER-DISP BLINKS MEAS START/NOT START

Measurement is only possible when the jitter display stops blinking. Measurement actually starts when the [START/STOP] key is pressed.

Measurement cannot start if a receiver BIT RATE LED (R-5) is blinking; if one is blinking, check the I/O signals.

3.4.8 Frequency offset method

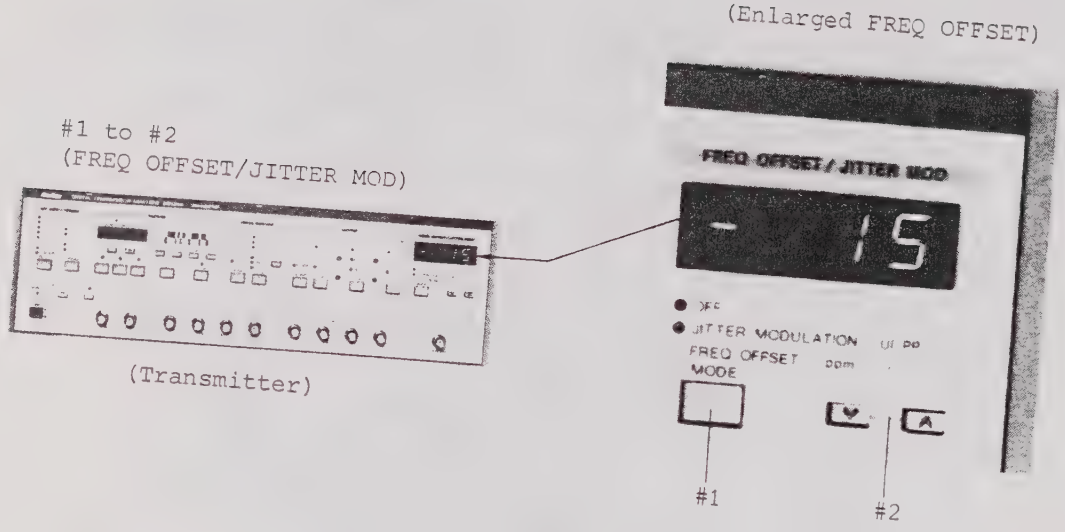


Fig. 3-15 Frequency Offset Method

Step	Procedure
(Transmitter only)	
#1	Set to FREQ OFFSET using the [MODE] switch.
#2	Set the desired value on the LED display using the [⩒] and [⩓] keys. The displayed value is in ppm. When the FREQ OFFSET lamp stops blinking, the output frequency matches the displayed value. To add jitter modulation in the frequency offset state, press [MODE] and set to JITTER MODULATION.

When the ME520B is used for a long time, or when the ambient temperature changes suddenly, the output frequency may change. If this happens, press [MODE] again to trigger the AFC loop.

3.4.9 Jitter modulation method 1

(When applying jitter modulation to the internal clock)

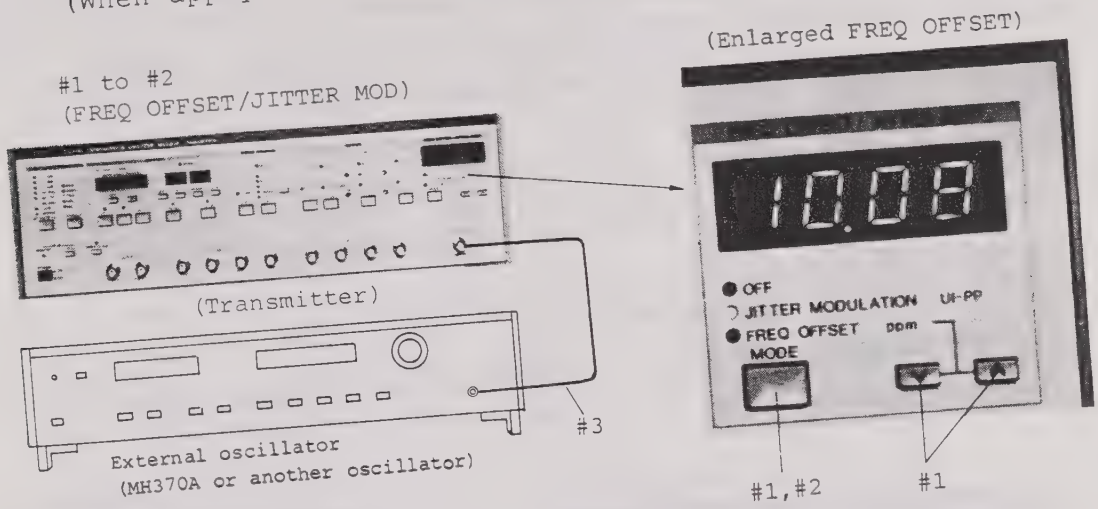


Fig. 3-16 Jitter Modulation Method 1

Step	Procedure
	Set BIT RATE to the desired values (except EXT) and follow procedure below.
	(Transmitter only)
#1	Set FREQ OFFSET using the [MODE] switch.
#2	Set the desired value using the [⩒] and [⩓] keys. Set to JITTER MODULATION using [MODE] switch.
#3	Connect the coaxial cable as shown in Fig. 3-16.
#4	Set the frequency of the external oscillator to the desired value. While monitoring the jitter display, adjust the output level of the external oscillator to the desired amount of jitter.

When using a receiver, connect the CLOCK OUTPUT T-8 of the transmitter to the CLOCK INPUT R-1 of the receiver. Measure the jitter amount with the receiver and set the jitter amount of the transmitter. (The receiver jitter display is more accurate than that of the transmitter.)

Note:

Refer to the MH370A operation manual for operation.

3.4.10 Jitter modulation method 2

(When applying jitter modulation to the external clock)

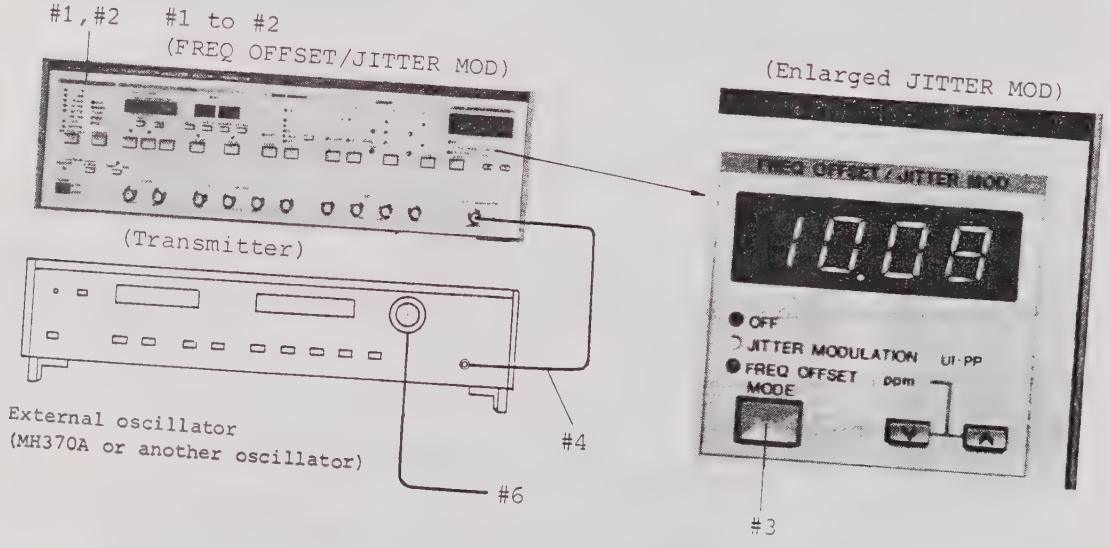


Fig. 3-17 Jitter Modulation Method 2

Step	Procedure
(Transmitter only)	
1	Set [BIT RATE] to EXT.
2	Set to JITTER MODULATION using [MODE] switch.

(cont.)

Step	Procedure
3	Specify the desired bit rate using [BIT RATE]. ("EXT" and other LEDs will light). Jitter can be modulated within ±10% of the frequency range shown at BIT RATE)
4	Connect the coaxial cable as shown in Fig. 3-17. Connect the rear panel connection as shown in the Fig. 3-10 in paragraph 3.4.3.
5	Set the frequency of the external oscillator to the desired value.
6	While monitoring the jitter display, adjust the output level of the external oscillator to the desired jitter amount.

When using a receiver, connect the CLOCK OUTPUT T-8 of the transmitter to the CLOCK INPUT R-1 of the receiver. Measure the jitter amount with the receiver and set the jitter amount of the transmitter. (The receiver jitter display is more acurate than that of the transmitter.)

Note:

Refer to the MH370A operation manual for operation.

3.4.11 Jitter measurement using external standard clock

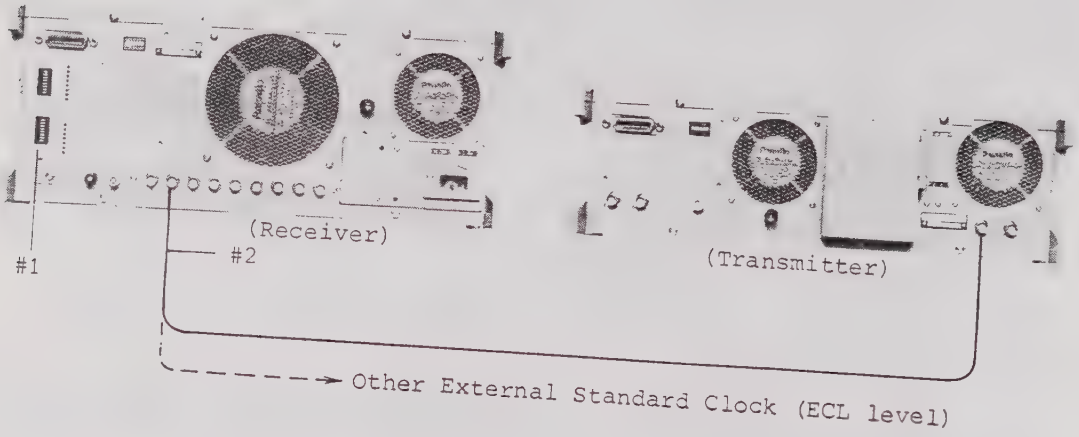


Fig. 3-18 Jitter Measurement Using External Standard Clock

Step	Procedure
#1	Set ADDITIONAL FUNCTION switch F of the receiver to EXT (0).
#2	Connect the coaxial cable as shown in Fig. 3-18. Jitter is measured in the same way as the internal reference clock. See paragraphs 3.4.5 to 3.4.7.

Measuring jitter using an external reference clock is the same as for an internal reference clock correlation between external and internal clocks is shown below, according to the clock frequency. For details on reference filters, etc, see paragraphs 3.4.5 to 3.4.7 on the internal reference clock.

F: External reference frequency (MHz)	Internal reference frequency (MHz)
0.7 ≦ F < 2.00	0.704
2.00 ≦ F < 3.00	2.048
8.00 ≦ F < 34.00	8.448
34.00 ≦ F < 68.00	34.368
68.00 ≦ F < 139.00	68.736
139.00 ≦ F <	139.264

Note:

Relationship between Jitter display RATE and lower frequency limit of the jitter measurement bandwidth is as follows;

RATE	Lower frequency limit
FAST	10 Hz
MED	1 Hz
SLOW	0.1 Hz

3.4.12 Clock frequency measurement

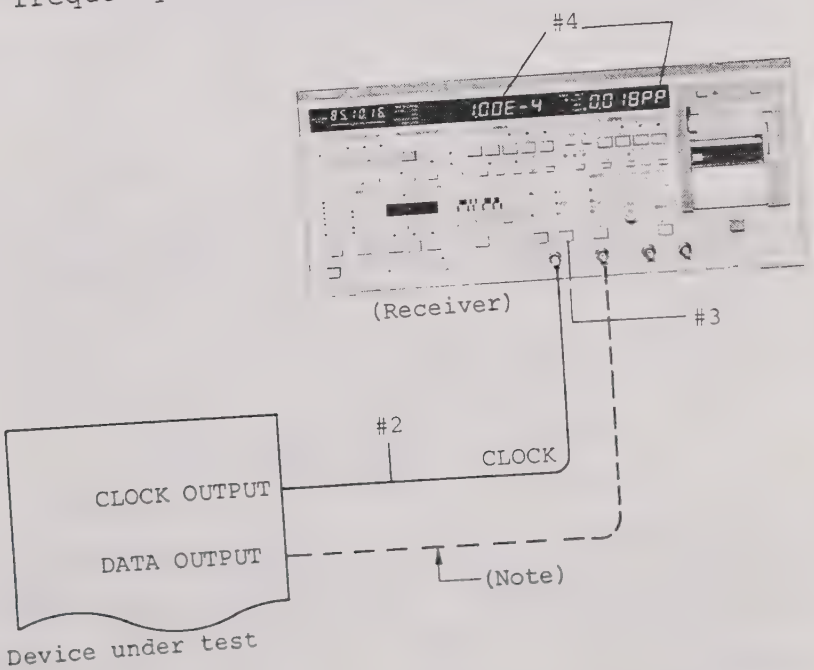


Fig. 3-19 Clock Frequency Measurement

Step	Procedure
(Receiver only)	
1	Set Z12 internal switch S1-2 to ON. Refer to paragraph 3.2.6 for details. 000 should be displayed on the jitter indicator.
2	Connect to the clock unit as shown in Fig. 3-19.
3	Set [THRESHOLD/TERM] according to the interface of the device under test.
4	The frequency input to the clock unit will be displayed on the ERROR and JITTER indicators at a resolution of 1 Hz. The measurement accuracy is $\leq \pm 2$ ppm at ambient temperature. Example: ERROR indicator 1 3 9 2 6 4 (↑ 1 kHz); JITTER indicator 1 0 9 (↑ 1 Hz)

Note:

When the connection indicated by the dashed line is made, the frequency measurements explained in paragraph 3.4.12 will not be affected.

3.4.13 Error measurement analyzing

There are two analyses methods for error measurement.

(1) The first is normal error measurement which has no error threshold. Normal error measurements are as follows:

error RATE
error COUNT
error INTVLS (Intervals)
error F. INTVLS (Free Intervals)

(2) The second is error performance measurement for measuring the error rate for one-second intervals. In this method, the result is compared with the error threshold and analyzed. The error performance parameters are as follows.

% US (% Unavailable Seconds)
% SES (% Severely Errored Seconds)
% DM (% Degraded Minutes)
% ES (% Errored Seconds)
% EFS (% Error Free Seconds)

(3) Error threshold changing

(A) %US, %SES error rate threshold

When %US or %SES is displayed and the SET key is pressed twice, each error threshold begins blinking and can be changed by using the [⩔] and [⩓] keys. The error rate threshold range and steps are indicated below.

error rate threshold range: 10^{-2} to 10^{-4}

[⩔] $\left(\begin{array}{l} 1 \times 10^{-2} \rightarrow 9 \times 10^{-3} \rightarrow 8 \times 10^{-3} \dashrightarrow \\ 2 \times 10^{-3} \rightarrow 1 \times 10^{-3} \rightarrow 9 \times 10^{-4} \rightarrow \\ 8 \times 10^{-4} \dashrightarrow 2 \times 10^{-4} \rightarrow 1 \times 10^{-4} \end{array}\right)$ 19 steps

[⩓] $\left(\begin{array}{l} 1 \times 10^{-4} \rightarrow 2 \times 10^{-4} \rightarrow 3 \times 10^{-4} \dashrightarrow \\ 9 \times 10^{-4} \rightarrow 1 \times 10^{-3} \rightarrow 2 \times 10^{-3} \rightarrow \\ 3 \times 10^{-3} \dashrightarrow 9 \times 10^{-3} \rightarrow 1 \times 10^{-2} \end{array}\right)$ 19 steps

(B) %DM error rate threshold

When %DM is displayed and the SET key is pressed twice, %DM threshold begins blinking and can be changed by using the [⩔] and [⩓] keys. The error rate threshold range and steps are indicated below.

error rate threshold range: 10^{-5} to 10^{-7}

[⩔] $\left(\begin{array}{l} 1 \times 10^{-5} \rightarrow 9 \times 10^{-6} \rightarrow 8 \times 10^{-6} \dashrightarrow \\ 2 \times 10^{-6} \rightarrow 1 \times 10^{-6} \rightarrow 9 \times 10^{-7} \rightarrow \\ 8 \times 10^{-7} \dashrightarrow 2 \times 10^{-7} \rightarrow 1 \times 10^{-7} \end{array}\right)$ 19 steps

[⩓] $\left(\begin{array}{l} 1 \times 10^{-7} \rightarrow 2 \times 10^{-7} \rightarrow 3 \times 10^{-7} \cdots \rightarrow \\ 9 \times 10^{-7} \rightarrow 1 \times 10^{-6} \rightarrow 2 \times 10^{-6} \rightarrow \\ 3 \times 10^{-6} \cdots \rightarrow 9 \times 10^{-6} \rightarrow 1 \times 10^{-5} \end{array}\right)$ 19 steps

(C) %US, %SES error count threshold

When the SET key is pressed twice, the most significant digit blinks and can be changed by using the [ ] and [⩓] keys as described in Items (A) and (B). When the SET key is pressed again, the blinking sequentially shifts from the most significant digit to the least digit. The blinking digit and the high-order digit can be changed by using the [⩔] or [⩓] keys.

The error count threshold range is indicated below.

error count threshold range: 1 to 999999
1.00×10^{6} to 1.99×10^{7}

When threshold is greater than 10^{6}, the display is shown in exponent.

(D) %DM error count threshold

The method of changing is the same as that described in Item (C).

error count threshold range: 1 to 999999
1.00×10^{6} to 1.99×10^{8}

When threshold is greater than 10^{6}, it is the same as Item (C).

(4) Error performance in the current mode

The result of the error performance parameters in the current mode is updated every second.

Fig. 3-20 shows the updated state of the %US and %SES when the %US and %SES error thresholds are set at 10^{-3}.

*1 Since the %SES result is not determined until one second after starting, the display is as follows.

———·———

*2 When the error rate exceeds 10^{-3} for ten consecutive seconds, it is determined to be an unavailable time.

*3 When the error rate does not exceed 10^{-3} for ten consecutive seconds, it is determined to be an available time.

*4 Since the measurement result cannot be determined to be US or SES at this point, the result from one second before is held.

*5 The result is determined to be US.

Fig. 3-21 shows the updated state of the %DM.

*6 Except for the SES, the %DM cannot be determined until 60 seconds have elapsed from the start. The display is as follows:

———·———

*7 The denominator is an available time, so it also includes the SES time.

*8 There was an 18-second unavailable time, so 18 seconds is subtracted from the denominator.

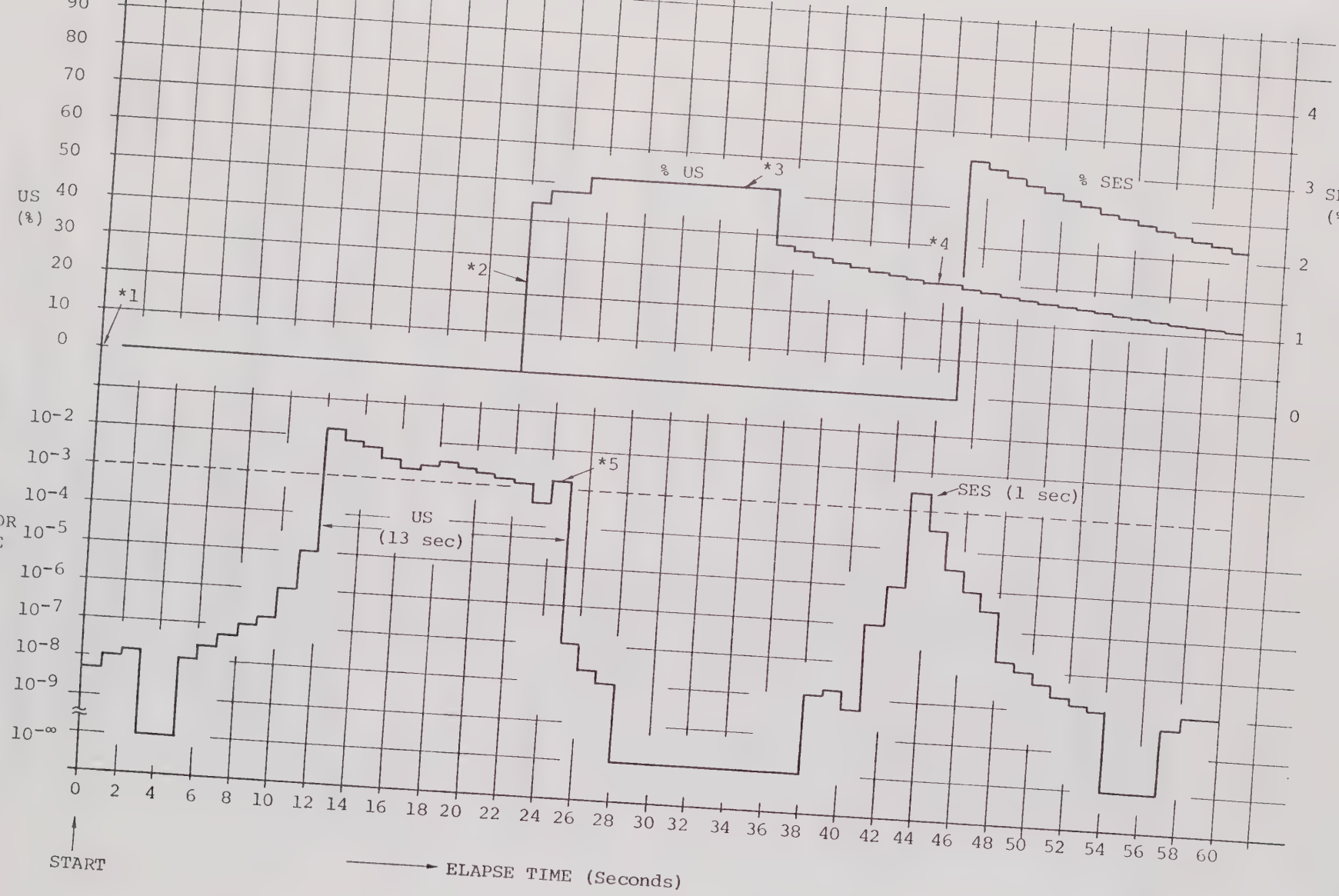


Fig. 3-20 %US and %SES at Current Mode

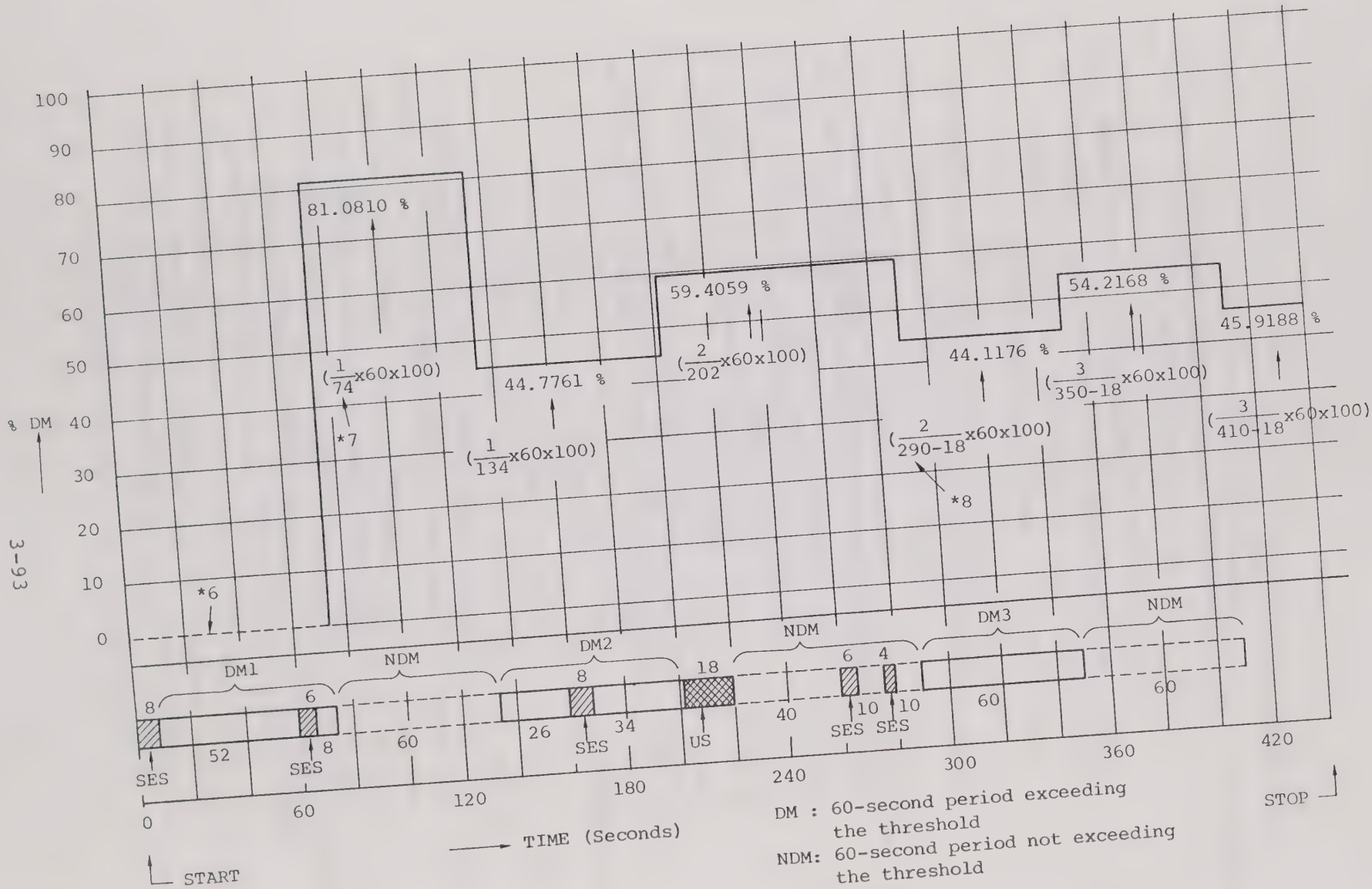


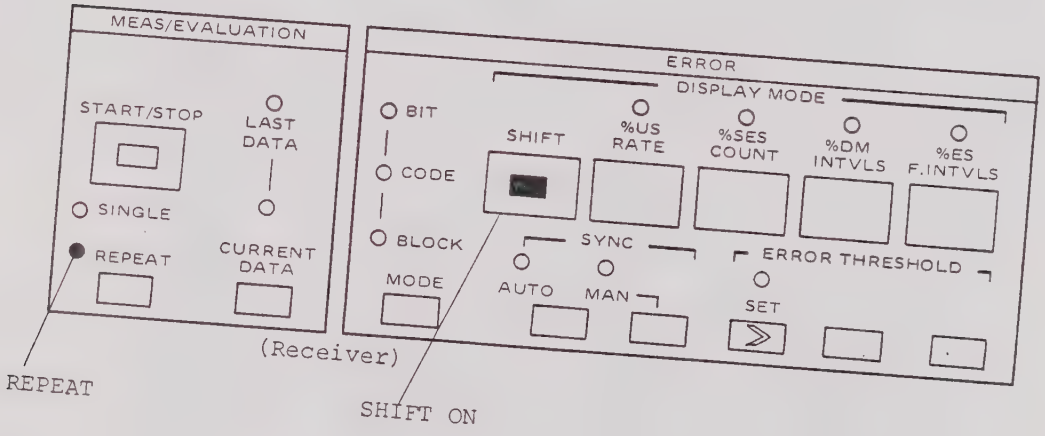
Fig. 3-21 %DM at Current Mode

(5) Error performance printing

Error performance measurement is usually used to measure long term system performance.

Three types of printing format, the CURRENT DATA mode, LAST DATA mode, and special error performance printing format for long-term error performance measurement, are provided in the ME520B.

The key operations required for the performance printing formats are explained below.



When the SHIFT key is "ON" in repeat measurement, the ERROR DISPLAY mode at measurement start, the error performance printing mode is set. Once this mode is set at the measurement start, the error performance mode cannot be released even if the SHIFT key is pressed again. In short, after measuring start, can be monitored the CURRENT data of error rate, error count and so on. In addition, if the measurement is started under a condition other than REPEAT or SHIFT ON, the LAST data or CURRENT data format is printed.

See paragraph 3.4.16 (8) for print output.

(6) Error performance evaluation and gating periods

The following five evaluation periods are provided for error performance:

1 15 minutes
2 1 hour
3 1 day
4 7 days
5 30 days

When each of above periods has elapsed after measurement start, the data and time are printed. When the measurement is stopped, performance data 1 to 5 are output. However, when the period from measurement start to stop is less than the periods of 1 to 5, "*" is printed as follows:

ERROR PERFORM (*1h)

When the gating period is set for longer times than the periods of 1 to 5, printing in that evaluation period is not performed. For example, when the gating period is set for sixteen minutes, 15-minute error performance data is not output. When the gating period is set for ten minutes and is measured for one month, the evaluation data of the evaluation periods of 1 to 5 are output.

For other than the evaluation periods of 1 to 5, the set performance data during the gating period is also output. However, we recommend that the following gating period be set to simplify post-measurement data.

[15, 30 minutes
1, 2, 3, 4, 6, 12 hours
1 day]

3.4.14 139.264 Mb/s CMI jitter measurement using MP547A

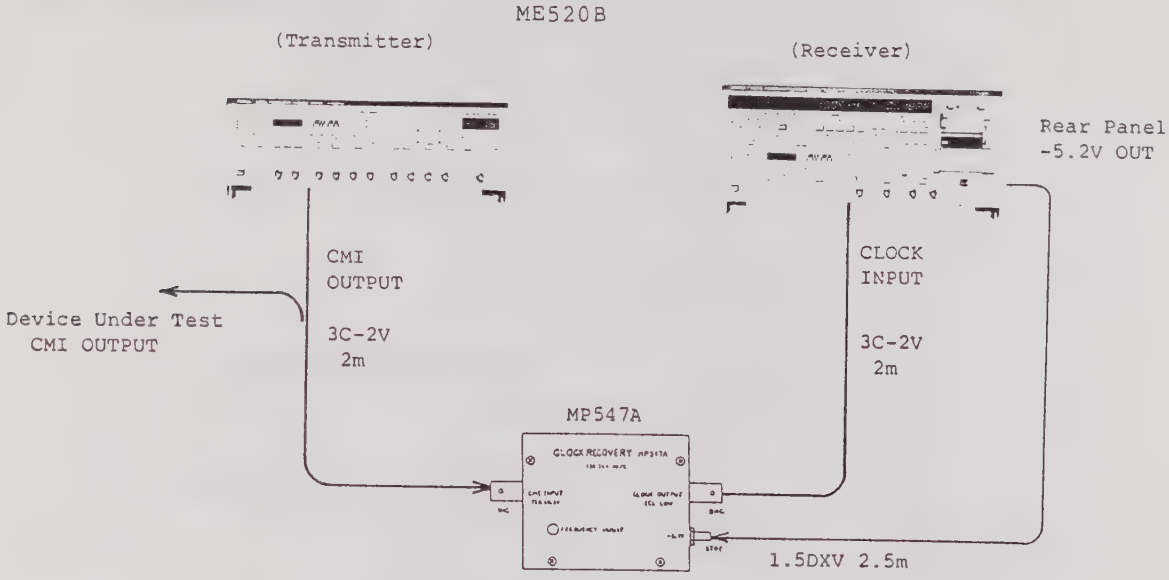


Fig. 3-22 139.264 Mb/s CMI Jitter Measurement (using MP547A)

Transmitter Setting	
BIT RATE	139,264
FORMAT	CMI
PATTERN	PRBS 2^{23}-1
FREQ OFFSET/ JITTER MOD	OFF

Receiver Setting		
BIT RATE	EXT	
FORMAT	NRZ	
PATTERN	WORD 0	
INPUT		
POLARITY	CLOCK	CLOCK
THRESHOLD	ECL	
THRESHOLD	ECL --- DATA	
MEAS/EVALUATION	CURRENT DATA	
JITTER		
RANGE	1 UIp-p	
RATE	FAST	
DISPLAY MODE	JITTER UIp-p	
FILTER	HPl + LP	

Step	Procedure
1	Set up as shown in Fig. 3-22.
2	Turn on the transmitter and receiver power.
3	Adjust the transmitter and receiver as shown in Fig. 3-22.
4	Wait until the receiver jitter display stops blinking.
5	Adjust the MP547A FREQUENCY ADJUST with a screw driver so that the jitter display is reduced to the smallest value.
6	After the MP547A power is turned on, the jitter display value will change due to the rise in internal temperature during the first 30 minutes.
7	Re-adjust as described in step 5.
8	If there is a sudden change in ambient temperature, the jitter display value will change for reasons described step 6; re-adjust as described step 5. The residual jitter of the MP547A will be less than 0.025 UIp-p. At an ambient temperature of 25°C, the typical value is less than 0.015 UIp-p (see Note).
9	Reconnect the CMI output of the device under test and the CMI INPUT of the MP547A with a 2-meter 3C-2V coaxial cable. When the blinking on the receiver jitter display stops the jitter of the device under test can be measured.

Notes:

1. Be sure to set the receiver INPUT CLOCK POLARITY to CLOCK, because of an increase in the residual jitter with $\overline{\text{CLOCK}}$ polarity. Also, set FORMAT with RZ formatting to NRZ, because of an increase in residual jitter.

2. The figure below shows a representative value of residual jitter change for a change in the input level. The input level for the MP547A should be in the range of ±0.2 V to ±0.5 V.

3. Refer to MP547A CLOCK RECOVERY Operation Manual for the MP547A detailed specification.

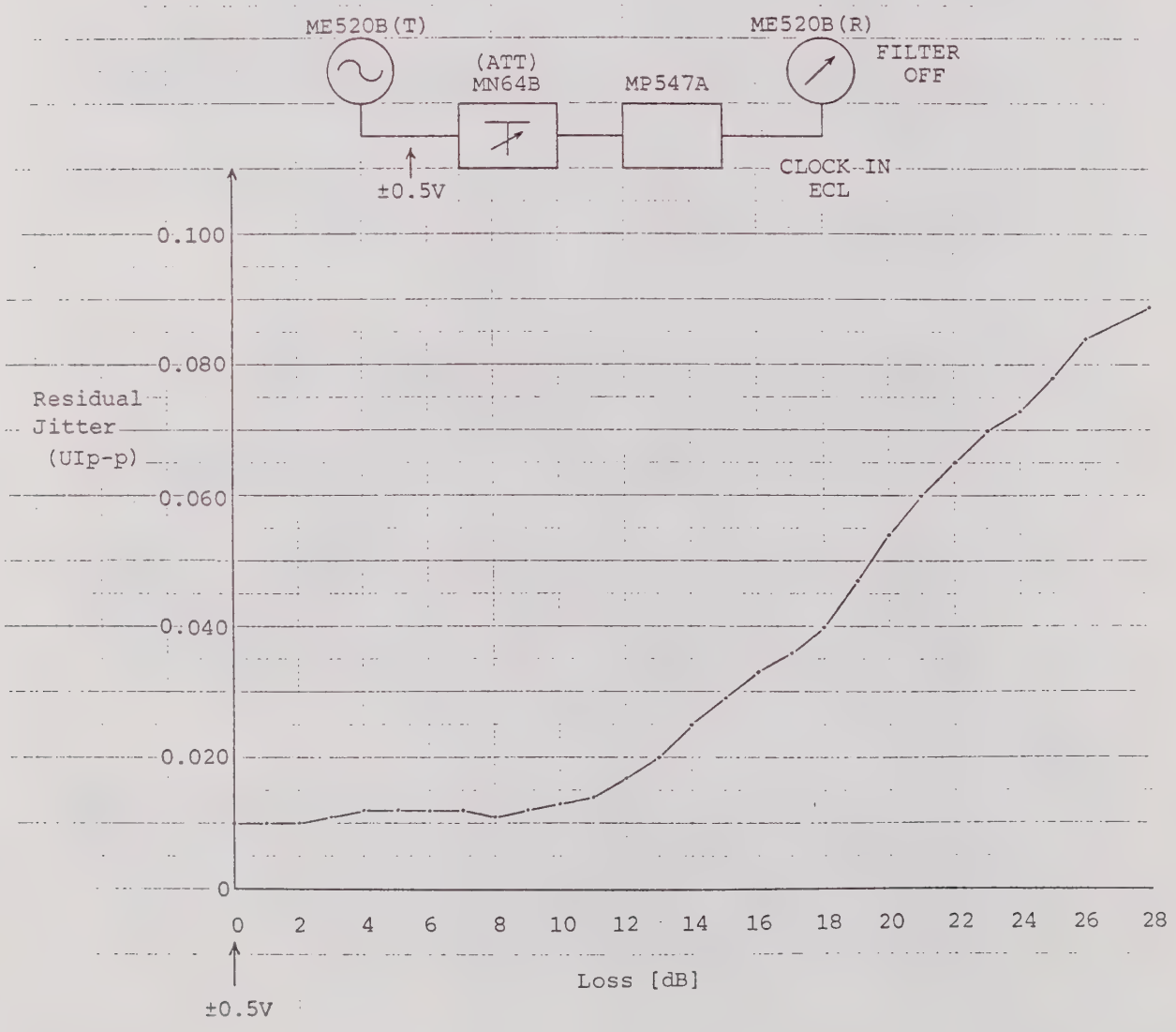


Fig. 3-23 Relationship between MP547A Input Level and Residual Jitter (139.264 Mb/s CMI)

3.4.15 Error rate recording

The 0.5 V step voltage corresponding to the exponent part of the error rate is updated each time the gating period ends.

The voltages corresponding to NO SIGNAL, SYNC LOSS and AIS are also output.

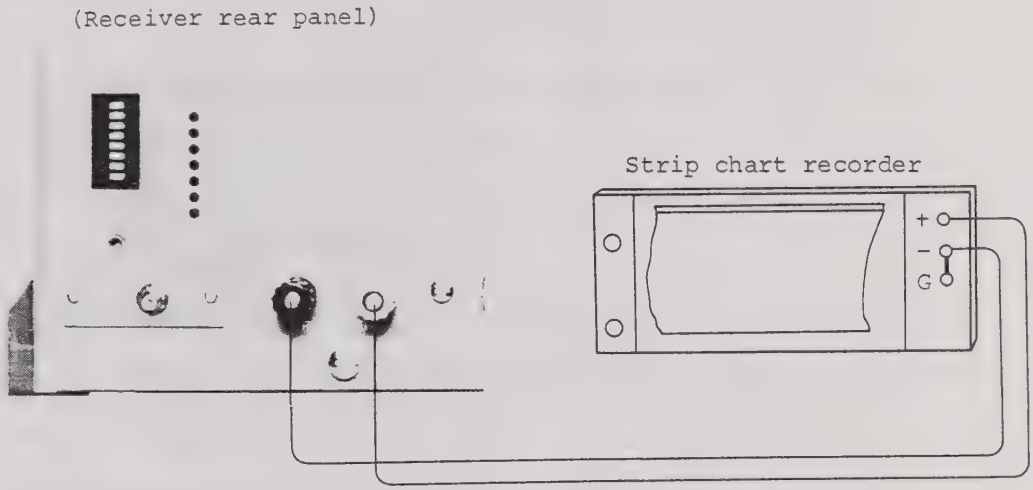


Fig. 3-24 Error Rate Recording

The relationship between error rate, status signal and output voltage is as follows:

Table 3-6 ERROR RATE OUTPUT Voltage

Status or ER	X ±0.2 V	ER or EC	X ±0.2 V
NO SIGNAL	10.0	$10^{-8} \leq ER < 10^{-7}$	5.0
SYNC LOSS	9.5	$10^{-9} \leq ER < 10^{-8}$	4.5
AIS	9.0	$10^{-10} \leq ER < 10^{-9}$	4.0
/	/	$10^{-11} \leq ER < 10^{-10}$	3.5
$10^{-2} \leq ER$	8.0	$10^{-12} \leq ER < 10^{-11}$	3.0
$10^{-3} \leq ER < 10^{-2}$	7.5	$10^{-13} \leq ER < 10^{-12}$	2.5
$10^{-4} \leq ER < 10^{-3}$	7.0	$10^{-14} \leq ER < 10^{-13}$	2.0
$10^{-5} \leq ER < 10^{-4}$	6.5	$10^{-15} \leq ER < 10^{-14}$	1.5
$10^{-6} \leq ER < 10^{-5}$	6.0	$ER < 10^{-15}$	1.0
$10^{-7} \leq ER < 10^{-6}$	5.5	/	/
		EC = 0	0.0

X : +Ve output voltage
ER : Error Rate
EC : Error Count

Step	Procedure
1	See paragraphs 3.4.1, 3.4.2 or 3.4.3 for the main panel settings of each format.
2	See Figs. 3-8, 3-9 or 3-10 for setting up the formats.
(Receiver)	
3	Set GATING PERIOD to [TIME]. Set the necessary period using the [⩔] and [⩓] keys.
4	MEAS/EVALUATION Select REPEAT measurement. Select LAST DATA or CURRENT DATA.
5	Connect the ERROR RATE OUTPUT and the STRIP CHART RECORDER INPUT as shown in Fig. 3-24.
(Strip chart recorder)	
6	Set input range to 10 V/full scale.
7	Set chart spead depending upon measurement to be done.

Press the [START/STOP] key for the strip chart recorder to record the step-formed amplitudes that correspond to the error rate exponent part, each time the gating period ends.

3.4.16 Thermal printer output (Option 01)

(1) Rear panel switches

The two receiver rear panel switches that control printing are shown below.

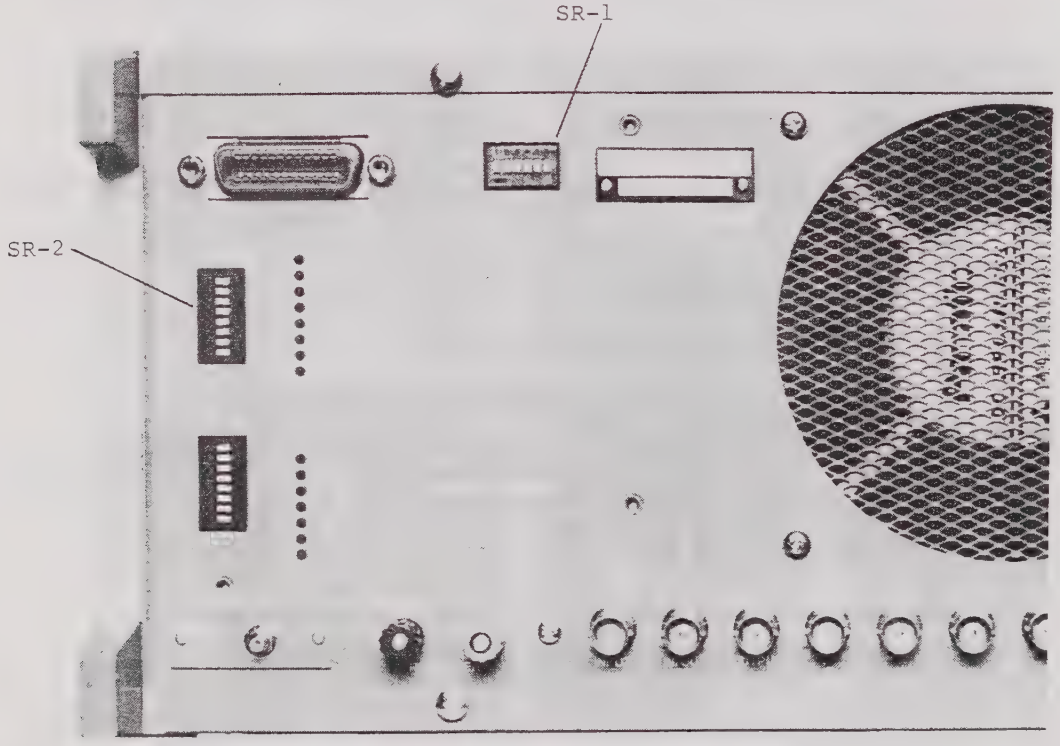


Fig. 3-25 Receiver Rear Panel Switches

The SR-1 switch is used in the TALK ONLY mode. For details see paragraph 5.3.3.

The SR-2 switch is used to set the PRINTER OUTPUT SELECTION.

(2) Printing formats

One printing format is selected from the five available types by setting a combination of the following keys.

MEAS/EVALUATION

(SINGLE
(REPEAT

(CURRENT DATA
(LAST DATA

ERROR

SHIFT on/off

Five printing formats are shown below, and the key combinations are shown enclosed in brackets [ ].

A SINGLE/CURRENT format
[SINGLE - CURRENT DATA]

B SINGLE/LAST format
[SINGLE - LAST DATA]

C REPEAT/CURRENT format
[REPEAT - CURRENT DATA - SHIFT off]

D REPEAT/LAST format
[REPEAT - LAST DATA - SHIFT off]

E Error performance format
[REPEAT - SHIFT on]

These five printing formats are determined by the key combinations at the start of measurement. After measurement starts, the printing formats cannot be changed even if the LAST DATA, CURRENT DATA, and SHIFT key combination is changed.

(3) Measurement condition printing

When the MEAS/EVALUATION [START/STOP] key is pressed, the following measurement conditions are printed out.

```
0.7Mb NRZ   PR23 BIT
%U 1.0E-3   %S 1.0E-3
%M 1.0E-6   PTH E
TIME 15s      IT 1s
PF SINGLE/CURRENT
ST 85-10-09 15:52:59
```

(i) 0.7 Mb

Prints the recovery bit rate set by the [RECOVERY] key or the bit rate input into the CLOCK INPUT as follows.

704	:	0.7 Mb
2048	:	2.0 Mb
8448	:	8.4 Mb
34368	:	34 Mb
68736	:	68 Mb
139264	:	139 Mb

For EXT, the bit rates input into the CLOCK INPUT are printed in two or three digits in kilobit (kb) or megabit (Mb) units.

(ii) NRZ

Prints the following formats set with the [FORMAT] key.

AMI
HDB3
CMI
NRZ
RZ

(iii) PR23

Prints the following receiver setting patterns. The setting values of ZERO SUBSTITUTION and WORD are not printed.

PRBS 2^{10}-1	:	PR10
PRBS 2^{15}-1	:	PR15
PRBS 2^{23}-1	:	PR23
WORD	:	WORD

(iv) BIT

Prints the following ERROR MODE settings.

BIT
CODE
BLOCK

(v) %U 1.0E-3, %S 1.0E-3, %M 1.0E-6

Prints the ERROR THRESHOLD set value of the ERROR PERFORMANCE. When the PRINTER OUTPUT SELECTION switch H on the rear panel of the receiver is set to "1", the error rate is printed, and when it is set to "0", the error count is printed.

error rate

%US	:	%U	1.0E-4 to 1.0E-2
%SES	:	%S	1.0E-4 to 1.0E-2
%DM	:	%M	1.0E-7 to 1.0E-5
(%Degraded Ten Minutes	:	%T	1.0E-8 to 1.0E-6)

error count

%US	:	%U	000001 to 1.99E7
%SES	:	%S	000001 to 1.99E7
%DM	:	%M	000001 to 1.99E8
(%DTM	:	%T	000001 to 1.99E7)

(vi) PTH E

Prints the print trigger set with the PRINTER OUTPUT SELECTION switches E, F, and G on the rear panel of the receiver in the current mode. The corresponding prints of the E, F, and G switch settings are:

E(1), F(0), G(0) : PTH S (print trigger threshold = threshold of the SES)

E(0), F(1), G(0) : PTH M (print trigger threshold = threshold of the DM)

E(0), F(0), G(1) : PTH E (print trigger threshold = threshold of the ES)

E(1), F(1), G(1) : PTH S, M, E

E(1), F(1), G(0) : PTH S, M

E(0), F(0), G(0) : PTH NO (print trigger threshold = no threshold)

None of these items are printed in the LAST mode or ERROR PERFORMANCE mode.

(vii) TIME 15s : gating period

Time gating:

TIME 1s to 59s
TIME 1m to 59m
TIME 1h to 23h
TIME 1d to 99d

For 1 hour and 15 minutes, TIME is 1h 15m.

Clock gating:

CLOCK 1E6 to 1E12

Manual gating:

MAN

(viii) IT 1s

Prints the following errors and hit intervals set with the ADDITIONAL FUNCTION switches C, D, and E on the rear panel of the receiver.

C(1), D(0), E(0) : IT 1s
C(0), D(1), E(0) : IT 0.1s
C(0), D(0), E(1) : IT 0.01s

(ix) PF SINGLE/CURRENT

Prints the printing format.

PF SINGLE/CURRENT
PF SINGLE/LAST
PF REPEAT/CURRENT
PF REPEAT/LAST
PF ERROR PERFORMANCE

(x) ST 85-10-09 15:52:59

Prints the start time.

85	1985	(year)
10	October	(month)
09	9th	(date)
15	15-hour	
52	52-minute	
59	59-second	

(4) SINGLE/CURRENT format

This format is set with a combination of SINGLE and CURRENT DATA. The [SHIFT] key is effective only for switching the error display mode; it has no other function.

The PRINTER OUTPUT SELECTION switches A to G on the rear panel are effective in this format.

Refer to Table 3-4 (R-22) for details on using the PRINTER OUTPUT SELECTION switches.

```
0.7Mb NRZ  PR23 BIT
%U 1.0E-3  %S 1.0E-3
%M 1.0E-6  PTH E
TIME 15s     IT 1s
PF SINGLE/CURRENT
ST 85-10-09 15:52:59
```

Measurement condition
(See paragraph (3))

```
ER 1.42E-06 15:53:00
ER 9.47E-07 15:53:02
ER 1.07E-06 15:53:03
ER 1.14E-06 15:53:04
ER 1.01E-06 15:53:06
ER 1.07E-06 15:53:07
ER 9.94E-07 15:53:09
ER 1.03E-06 15:53:10
ER 9.83E-07 15:53:12
ER 1.01E-06 15:53:13
```

Current printing
(See Note)

```
SP 85-10-09 15:53:14
```

Gating period stop time

```
ERROR
  RATE       1.04E-06
  COUNT            11
  INTVLS           10
  F.INTVLS          5
  F.INTVL%     33.333

ERROR PERFORM(15s  )
    ER       1.04E-06
  % US         0.0000
  % SES        0.0000
  % DM       * 0.0000
  % ES        73.3333
  % FES       26.6667

JITTER MAX
  UI PP          0.000
  UI +P          0.000
  UI -P          0.005

JITTER HIT(TH 0.500)
  COUNT             0
  INTVLS            0
  F.INTVLS         15
  F.INTVL%    100.000
```

Measurement between the start and stop times (15 seconds in this example).

* An asterisk * is printed when the evaluation period is less than one minute.

An asterisk * is printed before the data when the PLL circuit is unlocked in the NO SIGNAL state.

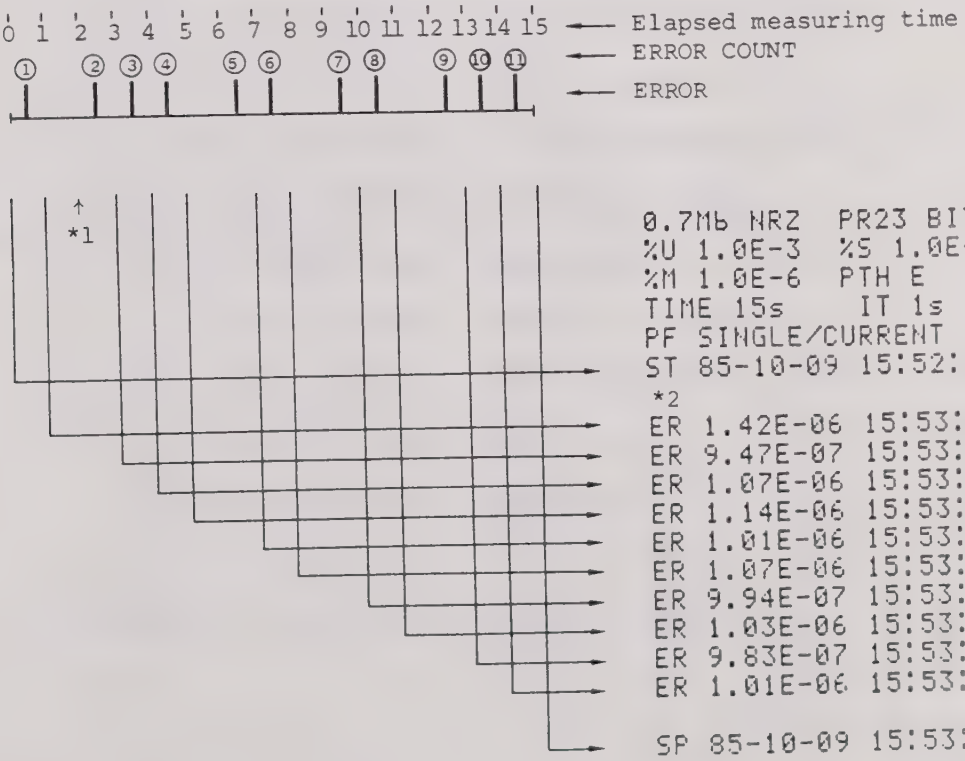
JITTER MAX
Prints maximum Jitter measured value in Gating period (during measurement).

Note:

Current printing

The items to be printed are selected with the PRINTER OUTPUT SELECTION switches A to D on the rear panel of the receiver. The following sample printout shows the front panel ERROR DISPLAY mode set to RATE with A(1), B(0) and C(0) switches settings (SHIFT OFF).

The print trigger threshold is selected with the PRINTER OUTPUT SELECTION switches E, F and G on the rear panel of the receiver. The following sample printout shows E(0), F(0) and G(1) switches settings. The threshold of the errored seconds is set to the print trigger threshold, so an error is printed every second when an error occurs (see the figure below).



*1 Nothing is printed for 15:53:01 since no error occurred between 15:53:00 and 15:53:01.

The printed error rate is an average of the rate between the start time (15:52:59) and the time the error is printed. An integrated value is printed for the error count.

*2 Explanation on Header

```
ER 9.60E-06 16:31:06  Error Rate
EC    80199 16:31:06  Error Count
EI     5781 16:31:06  Error Interval
EF      219 16:31:06  Error Free Intervals
EF%   3.649 16:31:06  Error Free Intervals %
%U   0.0000 16:31:06  % Unavailable seconds
%S   0.0000 16:31:06  % Severely errored seconds
%M 100.0000 16:31:06  % Degraded minutes
%E  96.6666 16:31:06  % Errored seconds
%F   3.3334 16:31:06  % Error free seconds
JU  0.017PP 16:31:06  Jitter UI p-p
JU  0.004+P 16:31:06  Jitter UI +peak
JU  0.013-P 16:31:06  Jitter UI -peak
JC        0 16:31:06  Jitter hit Count
JI        0 16:31:06  Jitter hit Intervals
JF     6000 16:31:06  Jitter hit Free intervals
J%  100.000 16:31:06  Jitter hit free intervals %
```

Select the threshold of the Degraded Minutes, when a print is to be triggered at the average error rate for a one minute period.

Set the PRINTER OUTPUT SELECTION switches on the rear panel of the receiver to E(0), F(1) and G(0).

Select the threshold of the Severely Errored Seconds, when the print is to be triggered at the average error rate for a one second period.

Set the PRINTER OUTPUT SELECTION switches on the rear panel of the receiver to E(1), F(0) and G(0).

Set the threshold to the error count, when these error thresholds are not adequate to trigger a required printing.

Set the PRINTER OUTPUT SELECTION switch on the rear panel to H(0).

For example, when a threshold of a one-second average error rate of 10^{-5} for 139.264 Mb/s is required, set the PRINTER OUTPUT SELECTION switches to E(1), F(0), G(0) and H(0), and the %SES error count threshold to 1393.

(5) SINGLE/LAST format

This format is set with a combination of SINGLE and LAST DATA. The [SHIFT] key is effective only for switching the error display mode; it has no other function.

Ignore the PRINTER OUTPUT SELECTION switches A to G on the rear panel for this format. The data, excluding the current printing of the SINGLE/CURRENT format, is printed.

```
0.7Mb NRZ  PR23 BIT
%U 1.0E-3  %S 1.0E-3
%M 1.0E-6
TIME 15s     IT 1s
PF SINGLE/LAST
ST 85-10-09 15:52:59

SP 85-10-09 15:53:14

ERROR
  RATE       1.04E-06
  COUNT            11
  INTVLS           10
  F.INTVLS          5
  F.INTVL%     33.333

ERROR PERFORM(15s  )
    ER       1.04E-06
  % US         0.0000
  % SES        0.0000
  % DM       * 0.0000
  % ES        73.3333
  % FES       26.6667

JITTER MAX
  UI PP          0.000
  UI +P          0.000
  UI -P          0.005

JITTER HIT(TH 0.500)
  COUNT             0
  INTVLS            0
  F.INTVLS         15
  F.INTVL%    100.000
```

Measurement condition (See paragraph (3))

Gating period stop time

Measured results between the start and stop times (15 seconds in this example).

* An asterisk * is printed when the evaluation period is less than one minute.

An asterisk * is printed before the data when the PLL circuit is unlocked in the NO SIGNAL state.

(6) REPEAT/CURRENT format

This format is set when the REPEAT, CURRENT DATA, and the [SHIFT] key is off.

The PRINTER OUTPUT SELECTION switches A to G on the rear panel are effective in this format. Refer to Table 3-4 (R22) for details on using the PRINTER OUTPUT SELECTION switches.

The data section of the SINGLE/CURRENT format are printed repeatedly.

```
139Mb CMI  PR23 BIT
%U 1.0E-3  %S 1.0E-3
%M 1.0E-6  PTH E
TIME 2m      IT 1s
PF REPEAT/CURRENT
ST 85-12-03 05:18:23

EC         1 05:18:28
EC         2 05:18:29
EC         3 05:18:33
EC         4 05:18:34
EC         5 05:18:36
EC         6 05:18:38
EC         7 05:18:39
EC         8 05:18:41
EC         9 05:18:43
EC        10 05:18:44

SP 85-12-03 05:20:23

ERROR
  RATE        5.98E-10
  COUNT             10
  INTVLS            10
  F.INTVLS         110
  F.INTVL%     91.666

ERROR PERFORM(2m    )
    ER        5.98E-10
  % US          0.0000
  % SES         0.0000
  % DM          0.0000
  % ES          8.3333
  % FES        91.6667

JITTER MAX
  UI PP          0.042
  UI +P          0.022
  UI -P          0.022

JITTER HIT(TH 0.500)
  COUNT              0
  INTVLS             0
  F.INTVLS         120
  F.INTVL%     100.000
```

```
EC         1 05:20:41
EC         2 05:20:42
EC         3 05:20:43
EC         4 05:20:44
EC         5 05:20:45
EC         6 05:20:46
EC         7 05:20:47
EC        10 05:20:49
EC        17 05:20:50
EC        21 05:20:51
EC        25 05:20:52

SP 85-12-03 05:22:23

ERROR
  RATE        1.50E-09
  COUNT             25
  INTVLS            11
  F.INTVLS         109
  F.INTVL%     90.833

ERROR PERFORM(2m    )
    ER        1.50E-09
  % US          0.0000
  % SES         0.0000
  % DM          0.0000
  % ES          9.1666
  % FES        90.8334

JITTER MAX
  UI PP          0.043
  UI +P          0.023
  UI -P          0.023

JITTER HIT(TH 0.500)
  COUNT              0
  INTVLS             0
  F.INTVLS         120
  F.INTVL%     100.000
```

Current printing

Gating period stop time

Measured results from 05:20:23 to 05:22:23

(7) REPEAT/LAST format

This format is set when the REPEAT, LAST DATA, and the [SHIFT] key is off.

The PRINTER OUTPUT SELECTION switches A to D on the rear panel are effective in this format. Ignore switches E, F and G.

Data is printed each time the gating period ends, and the items printed are selected with switches A to D.

```
139Mb CMI  PR23 BIT
%U 1.0E-3  %S 1.0E-4
%M 1.0E-6
TIME 1m      IT 0.01s
PF REPEAT/LAST
ST 85-12-06 16:51:18

ER 1.00E-05 16:52:18
EC     83559 16:52:18
EI      6000 16:52:18
EF         0 16:52:18
EF%    0.000 16:52:18
%U    0.0000 16:52:18
%S    0.0000 16:52:18
%M  100.0000 16:52:18
%E  100.0000 16:52:18
%F    0.0000 16:52:18
JU   0.024PP 16:52:18
JU   0.009+P 16:52:18
JU   0.015-P 16:52:18
JC         0 16:52:18
JI         0 16:52:18
JF      6000 16:52:18
J%  100.0000 16:52:18
ER 1.00E-05 16:53:18
EC     83558 16:53:18
EI      6000 16:53:18
EF         0 16:53:18
EF%    0.000 16:53:18
%U    0.0000 16:53:18
%S    0.0000 16:53:18
%M  100.0000 16:53:18
%E  100.0000 16:53:18
%F    0.0000 16:53:18
JU   0.025PP 16:53:18
JU   0.010+P 16:53:18
JU   0.015-P 16:53:18
JC         0 16:53:18
JI         0 16:53:18
JF      6000 16:53:18
J%  100.0000 16:53:18
```

```
139Mb CMI  PR23 BIT
%U 1.0E-3  %S 1.0E-4
%M 1.0E-6
TIME 1h      IT 0.01s
PF REPEAT/LAST
ST 85-12-07 00:00:00

ER 1.00E-03 01:00:00
ER 1.00E-04 02:00:00
ER 1.00E-05 03:00:00
ER 1.00E-06 04:00:00
ER 1.00E-07 05:00:00
ER 1.00E-03 06:00:00
ER 1.00E-04 07:00:00
ER 1.00E-05 08:00:00
ER 1.00E-06 09:00:00
ER 1.00E-07 10:00:00
ER 1.00E-03 11:00:00
ER 1.00E-04 12:00:00
ER 1.00E-05 13:00:00
ER 1.00E-06 14:00:00
ER 1.00E-07 15:00:00
ER 1.00E-05 16:00:00
ER 1.00E-06 17:00:00
ER 1.00E-07 18:00:00
ER 1.00E-03 19:00:00
ER 1.00E-04 20:00:00
ER 1.00E-05 21:00:00
ER 1.00E-06 22:00:00
ER 1.00E-07 23:00:00
```

(8) Error performance format (paragraph 3.4.13 (5) and (6))

This format is set by starting a measurement with the [START/STOP] key with the [SHIFT] key ON in the REPEAT format. Once a measurement is started, this format cannot be changed to another format while the measurement is in progress. It cannot be released, even if the [SHIFT] key is turned off, until the measurement is completed or halted.

Ignore the PRINTER OUTPUT SELECTION switches A to G for this format.

```
139Mb CMI  PR23 BIT
%U 1.0E-3  %S 1.0E-3
%M 1.0E-6
TIME 15m     IT 1s
PF ERROR PERFORMANCE
ST 85-12-03 06:31:29


SS 85-12-03 06:46:29

ERROR PERFORM(15m  )
    ER        1.04E-05
  % US          0.0000
  % SES         0.0000
  % DM          7.1174
  % ES          3.3333
  % EFS        96.66667

SS 85-12-03 07:01:29

ERROR PERFORM(15m  )
    ER        0.00E-12
  % US          0.0000
  % SES         0.0000
  % DM          0.0000
  % ES          0.0000
  % EFS       100.00000

SS 85-12-03 07:16:29

ERROR PERFORM(15m  )
    ER        2.54E-05
  % US          0.0000
  % SES         1.3333
  % DM          7.0175
  % ES          3.5555
  % EFS        96.4445

SS 85-12-03 07:31:29

ERROR PERFORM(15m  )
    ER        0.00E-12
  % US          0.0000
  % SES         0.0000
  % DM          0.0000
  % ES          0.0000
  % EFS       100.0000

SS 85-12-03 07:31:29

ERROR PERFORM(1h   )
    ER        8.94E-06
  % US          0.0000
  % SES         0.4166
  % DM          3.3755
  % ES          1.7222
  % EFS        98.2778
```

15 min. error performance data (from 06:31:29 to 06:46:29)

15 min. error performance data (from 06:46:29 to 07:01:29)

1 hour error performance data (from 06:31:29 to 07:31:29)

3.4.17 Printing paper replacement

A red mark on the edge of the thermal recording paper indicates that the paper is about to run out (1 m remaining). Replace the paper as follows:

Step	Procedure
1	Set the [PRINT] switch (#2) to OFF.
2	Push the [PRINTER EJECT] button (#3) under the printer (in Receiver front panel). This releases the printer lock mechanism so that it can spring forward. Hold the front of the unit and slowly pull the printer out until it stops (halfway, approximately 100 mm).
3	Remove the remaining paper and insert a new roll. The print side is on the outside of the roll. Before loading the paper, unroll approximately 300 mm as shown in the Fig. 3-26.
4	Lift lever #1 and feed the recording paper by hand through (c) and (d) shown in Fig. 3-26. If it is difficult to feed the paper through slot (c) and (d), trim the corners of the leading edge.
5	Pull the paper straight and press the [FEED] switch (#4) to feed the paper. The paper can also be fed using the feed wheel (#5).
6	Once the paper is in position, press lever (#1) down. Gently push the printer back in until it locks.
7	To resume printing, turn the [PRINT] switch (#2) to ON.

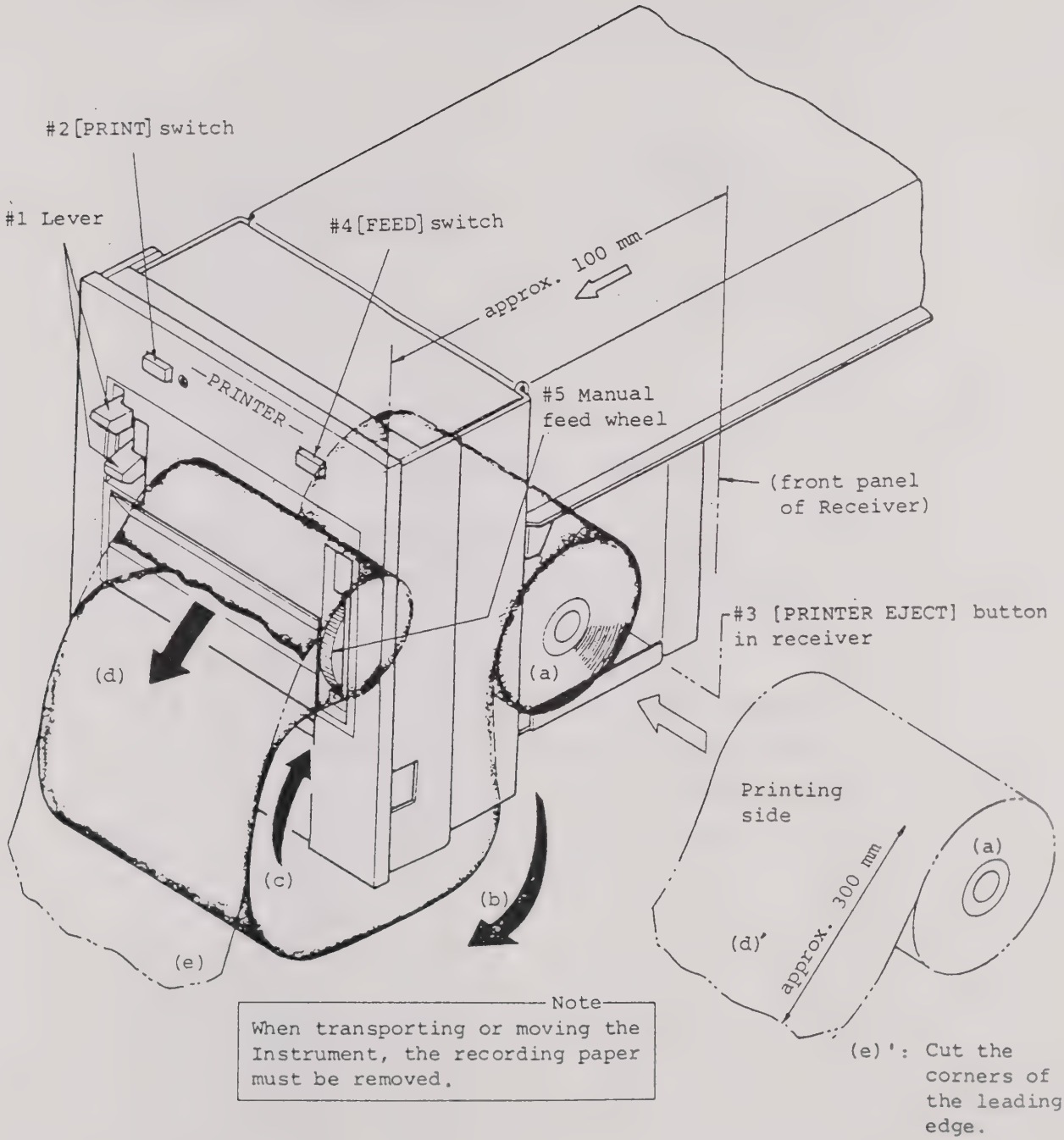
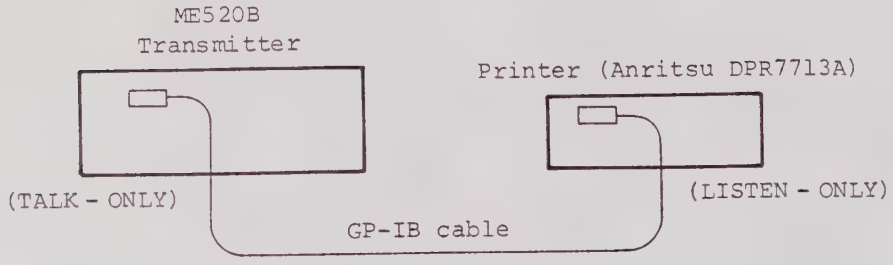


Fig. 3-26 Replacing Recording Paper

3.4.18 External printer printing (TALK-ONLY → LISTEN-ONLY)

(1) Transmitter



(See paragraph 5.3.3.)

Fig. 3-27 Transmitter Talk-Only

Set the FREQ OFFSET/JITTER MOD MODE (T-5) of the transmitter to JITTER MODULATION UI-PP in the Fig. 3-27 Setup.

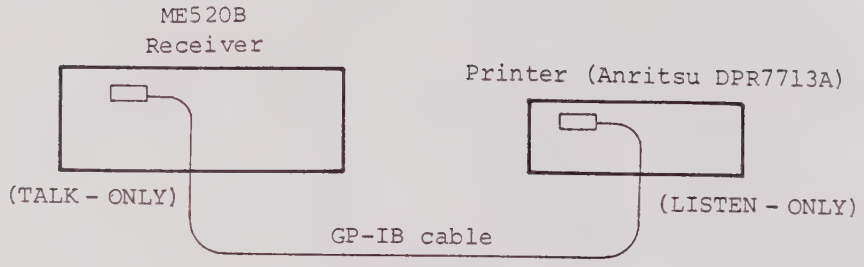
Then the jitter p-p data from the transmitter is updated every 0.6 s or 6 s. The 0.6 s or 6 s selection is performed by a internal dip switch (see paragraph 3.2.5).

A Print-out example is shown below.

Jitter modulation data printing
(Transmitter)

```
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   4.99 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   4.99 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   4.99 P-P
JITTER MODULATION=   4.99 P-P
JITTER MODULATION=   4.99 P-P
JITTER MODULATION=   4.99 P-P
JITTER MODULATION=   4.99 P-P
JITTER MODULATION=   4.99 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   5.00 P-P
JITTER MODULATION=   4.99 P-P
JITTER MODULATION=   5.01 P-P
JITTER MODULATION=   5.01 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.01 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.03 P-P
JITTER MODULATION=   5.03 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.01 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.01 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.03 P-P
JITTER MODULATION=   5.03 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.02 P-P
JITTER MODULATION=   5.01 P-P
```

(2) Receiver



(See paragraph 5.3.3.)

Fig. 3-28 Receiver Talk-Only

Prints-out to printer according to printing formats of five types. The printing format setting is performed as the same way as the internal thermal printer (see paragraph 3.4.16).

Print-out examples of the five types are shown below.

(i) SINGLE/CURRENT

- MEAS/EVALUATION — SINGLE CURRENT DATA
- PRINTER OUTPUT SELECTION

A = 1
B = 0
C = 0
D = 0
E = 0
F = 0
G = 1
H = 1

```
TIME=86-01-09 15/12/36
GATING PERIOD=TIME 15S
ERROR MODE=BIT
BIT RATE=EXTERNAL
FORMAT=NRZ
PATTERN=PRBS 2^23-1
INPUT= CLOCK POS ECL NRZ/RZ ECL
MEASURE/EVALUATION=START SINGLE CURRENT
JITTER RANGE=1 RATE=FAST
JITTER FILTER=OFF
JITTER HIT THRESHOLD=0.500
ERROR PERFORMANCE THRESHOLD (RATE    US 1.0E-3  SES 1.0E-3  DM 1.0E-6)
PRINTER THRESHOLD=%ES
INTERVAL-TIME=1s
CURRENT 86-01-09 15/12/42
ERROR RATE            2.84E-07
CURRENT 86-01-09 15/12/43
ERROR RATE            4.74E-07
CURRENT 86-01-09 15/12/44
ERROR RATE            6.09E-07
CURRENT 86-01-09 15/12/45
ERROR RATE            7.10E-07
CURRENT 86-01-09 15/12/46
ERROR RATE            7.89E-07
CURRENT 86-01-09 15/12/47
ERROR RATE            8.52E-07
CURRENT 86-01-09 15/12/48
ERROR RATE            9.04E-07
CURRENT 86-01-09 15/12/49
ERROR RATE            9.47E-07
CURRENT 86-01-09 15/12/50
ERROR RATE            9.83E-07
CURRENT 86-01-09 15/12/51
ERROR RATE            1.01E-06
START 86-01-09 15/12/36  STOP 86-01-09 15/12/52
ERROR RATE            9.47E-07
ERROR COUNT                 10
ERROR INTVLS                10
ERROR F.INTVLS               5
ERROR F.INTVL%          33.333
  ER                  9.47E-07
% US                     0.0000
% SES                    0.0000
% DM                   * 0.0000
% ES                    66.6666
% EFS                   33.3334
JITTER UI PP              0.002
JITTER UI +P              0.000
JITTER UI -P              0.002
JITTER HIT COUNT              0
JITTER HIT INTVLS             0
JITTER HIT F.INTVLS          15
JITTER HIT F.INTVL%     100.000
```

(DPR7713A)

```
0.7Mb NRZ  PR23 BIT
%U 1.0E-3  %S 1.0E-3
%M 1.0E-6  PTH E
TIME 15s     IT 1s
PF SINGLE/CURRENT
ST 86-01-09 15:12:36

ER 2.84E-07 15:12:41
ER 4.74E-07 15:12:42
ER 6.09E-07 15:12:43
ER 7.10E-07 15:12:44
ER 7.89E-07 15:12:45
ER 8.52E-07 15:12:46
ER 9.04E-07 15:12:47
ER 9.47E-07 15:12:48
ER 9.83E-07 15:12:49
ER 1.01E-06 15:12:50

SP 86-01-09 15:12:52

ERROR
  RATE       9.47E-07
  COUNT             10
  INTVLS            10
  F.INTVLS           5
  F.INTVL%      33.333

ERROR PERFORM(15s  )
    ER       9.47E-07
  % US         0.0000
  % SES        0.0000
  % DM       * 0.0000
  % ES        66.6666
  % EFS       33.3334

JITTER MAX
  UI PP          0.002
  UI +P          0.000
  UI -P          0.002

JITTER HIT(TH 0.500)
  COUNT              0
  INTVLS             0
  F.INTVLS          15
  F.INTVL%     100.000
```

(Internal Printer)

(ii) SINGLE/LAST

- MEAS/EVALUATION SINGLE
  LAST DATA

- PRINTER OUTPUT SELECTION

H = 1

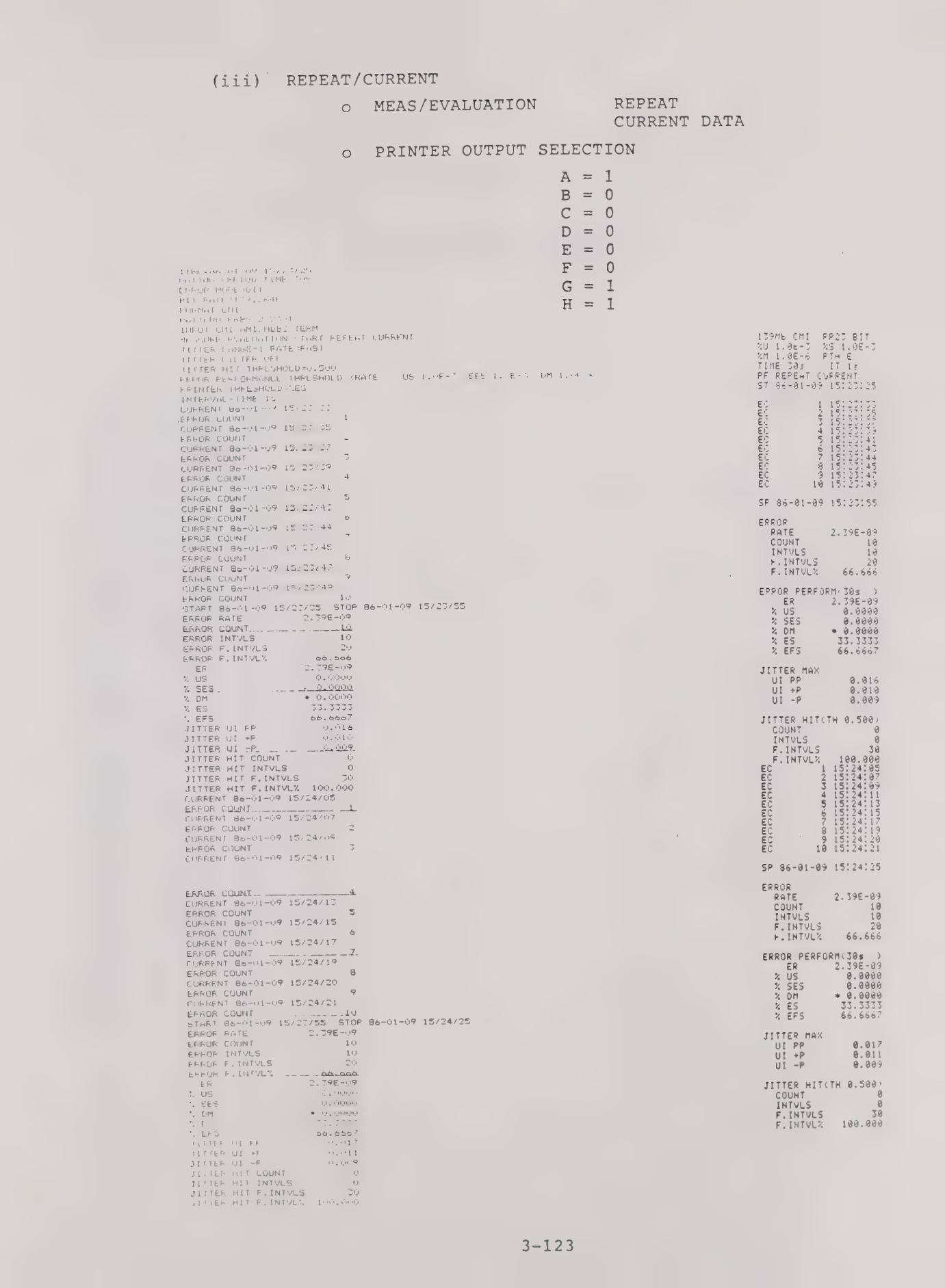
```
TIME=86-01-09 15/17/18
GATING PERIOD=TIME 15S
ERROR MODE=BIT
BIT RATE=EXTERNAL
FORMAT=NRZ
PATTERN=PRBS 2^23-1
INPUT= CLOCK POS ECL NRZ/RZ ECL
MEASURE/EVALUATION=START SINGLE LAST
JITTER RANGE=1 RATE=FAST
JITTER FILTER=OFF
JITTER HIT THRESHOLD=0.500
ERROR PERFORMANCE THRESHOLD (RATE    US 1.0E-3  SES 1.0E-3  DM 1.0E-6)
INTERVAL-TIME=1s
START 86-01-09 15/17/18  STOP 86-01-09 15/17/33
ERROR RATE            1.00E-04
ERROR COUNT               1056
ERROR INTVLS                15
ERROR F.INTVLS               0
ERROR F.INTVL%           0.000
  ER                  1.00E-04
% US                    0.0000
% SES                   0.0000
% DM                  * 0.0000
% ES                  100.0000
% EFS                   0.0000
JITTER UI PP             0.002
JITTER UI +P             0.000
JITTER UI -P             0.002
JITTER HIT COUNT             0
JITTER HIT INTVLS            0
JITTER HIT F.INTVLS         15
JITTER HIT F.INTVL%   100.000
```

```
0.7Mb NRZ  PRBS BIT
%U 1.0E-3  %S 1.0E-3
%M 1.0E-6
TIME 15s     IT 1s
PF SINGLE LAST
ST 86-01-09 15:17:18

SP 86-01-09 15:17:33

ERROR
  RATE        1.00E-04
  COUNT           1056
  INTVLS            15
  F.INTVLS           0
  F.INTVL%       0.000

ERROR PERFORM(15s  )
    ER        1.00E-04
  % US          0.0000
  % SES         0.0000
  % DM        * 0.0000
  % ES        100.0000
  % EFS         0.0000

JITTER MAX
  UI PP           0.002
  UI +P           0.000
  UI -P           0.002

JITTER HIT(TH 0.500)
  COUNT              0
  INTVLS             0
  F.INTVLS          15
  F.INTVL%     100.000
```

(iii) REPEAT/CURRENT

- o MEAS/EVALUATION — REPEAT CURRENT DATA
- o PRINTER OUTPUT SELECTION

A = 1
B = 0
C = 0
D = 0
E = 0
F = 0
G = 1
H = 1



(iv) REPEAT/LAST

- o MEAS/EVALUATION — REPEAT
  LAST DATA

- o PRINTER OUTPUT SELECTION

  A = 1
  B = 1
  C = 1
  D = 1
  H = 1

```
TIME=86-01-14 16/21/26
GATING PERIOD=TIME 1M
ERROR MODE=BIT
BIT RATE=139,264K
FORMAT=CMI
PATTERN=PRBS 2^23-1
INPUT=CMI/AMI/HDB3 TERM
MEASURE/EVALUATION=START REPEAT LAST
JITTER RANGE=1 RATE=FAST
JITTER FILTER=OFF
JITTER HIT THRESHOLD=0.500
ERROR PERFORMANCE THRESHOLD (RATE    US 1.0E-3  SES 1.0E-3
INTERVAL-TIME=0.1s                              DM 1.0E-6)
LAST    86-01-14 16/22/26
ERROR RATE          1.00E-05
ERROR COUNT            83558
ERROR INTVLS             600
ERROR F.INTVLS             0
ERROR F.INTVL%         0.000
% US                   0.0000
% SES                  0.0000
% DM                 100.0000
% ES                 100.0000
% EFS                  0.0000
JITTER UI PP           0.041
JITTER UI +P           0.021
JITTER UI -P           0.021
JITTER HIT COUNT           0
JITTER HIT INTVLS          0
JITTER HIT F.INTVLS      600
JITTER HIT F.INTVL%  100.000
LAST    86-01-14 16/23/26
ERROR RATE          1.00E-05
ERROR COUNT            83559
ERROR INTVLS             600
ERROR F.INTVLS             0
ERROR F.INTVL%         0.000
% US                   0.0000
% SES                  0.0000
% DM                 100.0000
% ES                 100.0000
% EFS                  0.0000
JITTER UI PP           0.042
JITTER UI +P           0.022
JITTER UI -P           0.022
JITTER HIT COUNT           0
JITTER HIT INTVLS          0
JITTER HIT F.INTVLS      600
JITTER HIT F.INTVL%  100.000
```

```
139Mb CMI  PR23 BIT
%U 1.0E-3  %S 1.0E-3
%M 1.0E-6
TIME 1m      IT 0.1s
PF REPEAT/LAST
ST 86-01-14 16:21:26

ER 1.00E-05 16:22:26
EC     83558 16:22:26
EI       600 16:22:26
EF         0 16:22:26
EF%    0.000 16:22:26
%U    0.0000 16:22:26
%S    0.0000 16:22:26
%M  100.0000 16:22:26
%E  100.0000 16:22:26
%F    0.0000 16:22:26
JU   0.041PP 16:22:26
JU   0.021+P 16:22:26
JU   0.021-P 16:22:26
JC         0 16:22:26
JI         0 16:22:26
JF       600 16:22:26
J%   100.000 16:22:26
ER 1.00E-05 16:23:26
EC     83559 16:23:26
EI       600 16:23:26
EF         0 16:23:26
EF%    0.000 16:23:26
%U    0.0000 16:23:26
%S    0.0000 16:23:26
%M  100.0000 16:23:26
%E  100.0000 16:23:26
%F    0.0000 16:23:26
JU   0.042PP 16:23:26
JU   0.022+P 16:23:26
JU   0.022-P 16:23:26
JC         0 16:23:26
JI         0 16:23:26
JF       600 16:23:26
J%   100.000 16:23:26
```

(v) REPEAT/LAST

- o MEAS/EVALUATION — REPEAT LAST DATA
- o PRINTER OUTPUT SELECTION

A = 1
B = 0
C = 0
D = 0
H = 1

```
TIME=86-01-09 15/51/00
GATING PERIOD=TIME 10S
ERROR MODE=BIT
BIT RATE=139,264K
FORMAT=CMI
PATTERN=PRBS 2^23-1
INPUT=CMI/AMI/HDB3 TERM
MEASURE/EVALUATION=START REPEAT LAST
JITTER RANGE=1 RATE=FAST
JITTER FILTER=OFF
JITTER HIT THRESHOLD=0.500
ERROR PERFORMANCE THRESHOLD{(RATE    US 1.0E-3  SES 1.0E-3
INTERVAL-TIME=0.01s                             DM 1.0E-6)
LAST    86-01-09 15/51/10
ERROR RATE          1.00E-05
LAST    86-01-09 15/51/20
ERROR RATE          1.00E-05
LAST    86-01-09 15/51/30
ERROR RATE          1.00E-05
LAST    86-01-09 15/51/40
ERROR RATE          1.00E-05
LAST    86-01-09 15/51/50
ERROR RATE          1.00E-05
LAST    86-01-09 15/52/00
ERROR RATE          1.00E-05
LAST    86-01-09 15/52/10
ERROR RATE          1.00E-05
LAST    86-01-09 15/52/20
ERROR RATE          1.00E-05
LAST    86-01-09 15/52/30
ERROR RATE          1.00E-05
LAST    86-01-09 15/52/40
ERROR RATE          1.00E-05
LAST    86-01-09 15/52/50
ERROR RATE          1.00E-05
LAST    86-01-09 15/53/00
ERROR RATE          1.00E-05
LAST    86-01-09 15/53/10
ERROR RATE          1.00E-05
LAST    86-01-09 15/53/20
ERROR RATE          1.00E-05
LAST    86-01-09 15/53/30
ERROR RATE          1.00E-05
LAST    86-01-09 15/53/40
ERROR RATE          1.00E-05
```

```
139Mb CMI  PR23 BIT
%U 1.0E-3  %S 1.0E-3
%M 1.0E-6
TIME 10s     IT 0.01s
PF REPEAT/LAST
ST 86-01-09 15:51:00

ER 1.00E-05 15:51:10
ER 1.00E-05 15:51:20
ER 1.00E-05 15:51:30
ER 1.00E-05 15:51:40
ER 1.00E-05 15:51:50
ER 1.00E-05 15:52:00
ER 1.00E-05 15:52:10
ER 1.00E-05 15:52:20
ER 1.00E-05 15:52:30
ER 1.00E-05 15:52:40
ER 1.00E-05 15:52:50
ER 1.00E-05 15:53:00
ER 1.00E-05 15:53:10
ER 1.00E-05 15:53:20
ER 1.00E-05 15:53:30
ER 1.00E-05 15:53:40
```

(vi) STATUS PRINTING

```
TIME=86-01-16 16/14/41
GATING PERIOD=MAN
ERROR MODE=BIT
BIT RATE=EXTERNAL
FORMAT=NRZ
PATTERN=PRBS 2^23-1
INPUT= CLOCK POS ECL NRZ/RZ ECL
MEASURE/EVALUATION=START SINGLE CURRENT
JITTER RANGE=1 RATE=FAST
JITTER FILTER=LP
JITTER HIT THRESHOLD=0.500
ERROR PERFORMANCE THRESHOLD (RATE    US 1.0E-3  SES 1.0E-3  DM 1.0E-6)
PRINTER THRESHOLD=NO
INTERVAL-TIME=0.1s

                                  SYNC LOSS   86-01-16 16/14/51
                                  SYNC GAIN   86-01-16 16/14/55
                                  AIS ON      86-01-16 16/14/58
                                  SYNC LOSS   86-01-16 16/14/58
                                  AIS OFF     86-01-16 16/15/16
                                  SYNC GAIN   86-01-16 16/15/16
                                  NO SIGNAL   86-01-16 16/15/22
                                  SIGNAL GAIN 86-01-16 16/15/26
                                  POWER DOWN  86-01-16 16/15/28
                                  POWER UP    86-01-16 16/15/37
START 86-01-16 16/14/41  STOP 86-01-16 16/16/23
ERROR RATE              1.19E-01
ERROR COUNT             1.51E09
ERROR INTVLS                218
ERROR F.INTVLS              685
ERROR F.INTVL%           75.858
  ER                    1.20E-01
% US                    20.4301
% SES                    6.7567
% DM                     0.0000
% ES                     6.7567
% EFS                   93.2433
JITTER UI PP        *     1.022
JITTER UI +P        *     0.639
JITTER UI -P        *     0.511
JITTER HIT COUNT    *    206055
JITTER HIT INTVLS   *        48
JITTER HIT F.INTVLS*       855
JITTER HIT F.INTVL%*    94.684
```

```
139Mb NRZ  PR23 BIT
%U 1.0E-3  %S 1.0E-3
%M 1.0E-6  PTH NO
MAN          IT 0.1s
PF SINGLE/CURRENT
ST 86-01-16 16:14:41

SYNC LOSS   16:14:51
SYNC GAIN   16:14:55
AIS ON      16:14:58
SYNC LOSS   16:14:58
AIS OFF     16:15:16
SYNC GAIN   16:15:16
NO SIGNAL   16:15:22
SIGNAL GAIN 16:15:26
POWER DOWN  16:15:28
POWER UP    16:15:37
SP 86-01-16 16:16:23

ERROR
  RATE       1.19E-01
  COUNT       1.51E09
  INTVLS          218
  F.INTVLS        685
  F.INTVL%     75.858

ERROR PERFORM(MAN  )
    ER       1.20E-01
  % US        20.4301
  % SES        6.7567
  % DM         0.0000
  % ES         6.7567
  % EFS       93.2433

JITTER MAX
  UI PP        *1.022
  UI +P        *0.639
  UI -P        *0.511

JITTER HIT(TH 0.500)
  COUNT     * 206055
  INTVLS    *     48
  F.INTVLS  *    855
  F.INTVL%  * 94.684
```

(vii) ERROR PERFORMANCE

- o MEAS/EVALUATION REPEAT
- o ERROR DISPLAY MODE

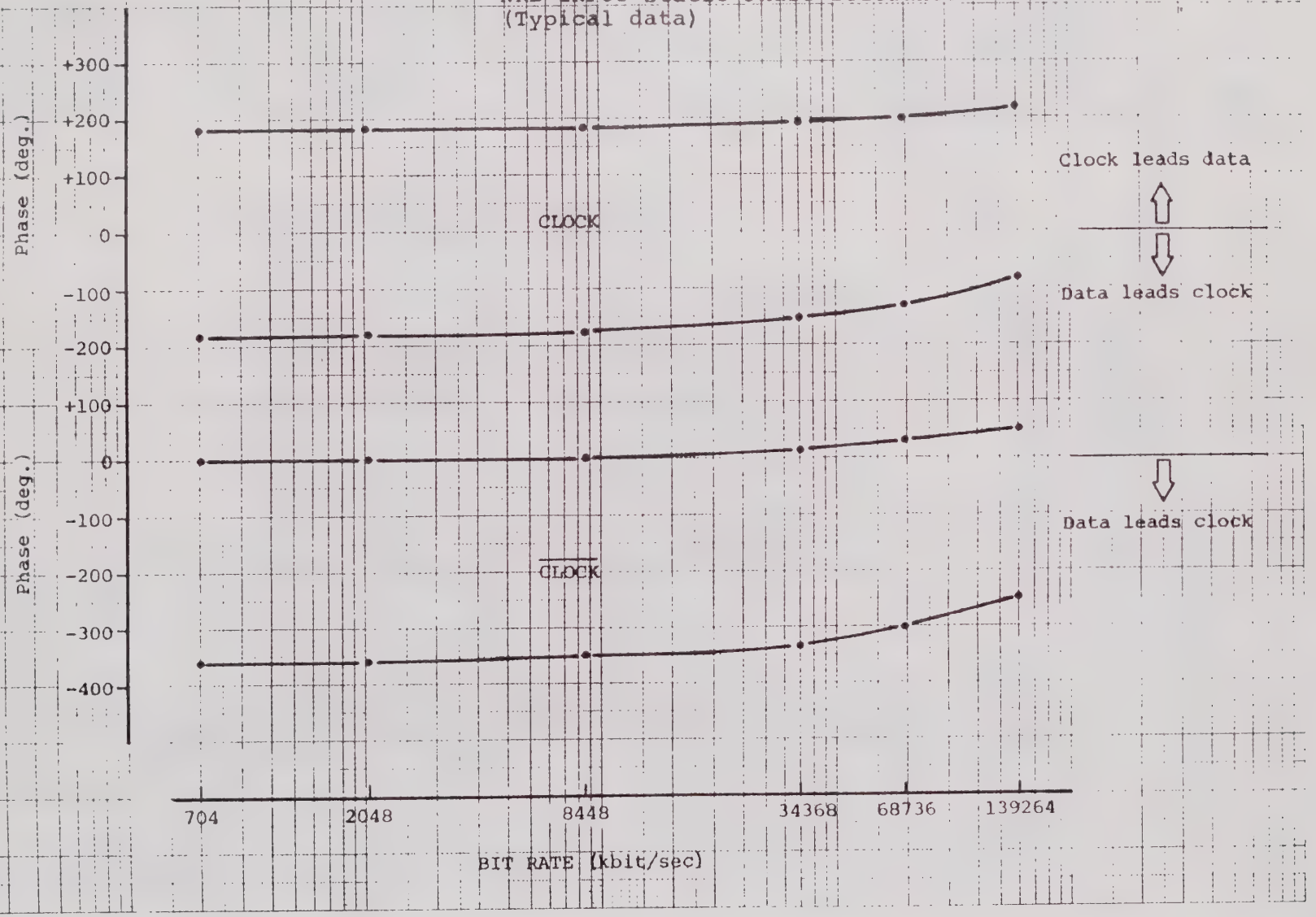
  SHIFT = on
- o PRINTER OUTPUT SELECTION

  H = 1

```
                    :
   START            :     86/01/17 20:35:32

BR-139Mb/s,FORMAT-CMI ,PATTERN-FRBS23,BIT  ERROR,GATING-TIME 2h0m
ERROR PERFORMANCE THRESHOLD (RATE:   US 5.0E-7  SES 5.0E-4  DM 5.0E-6)
```

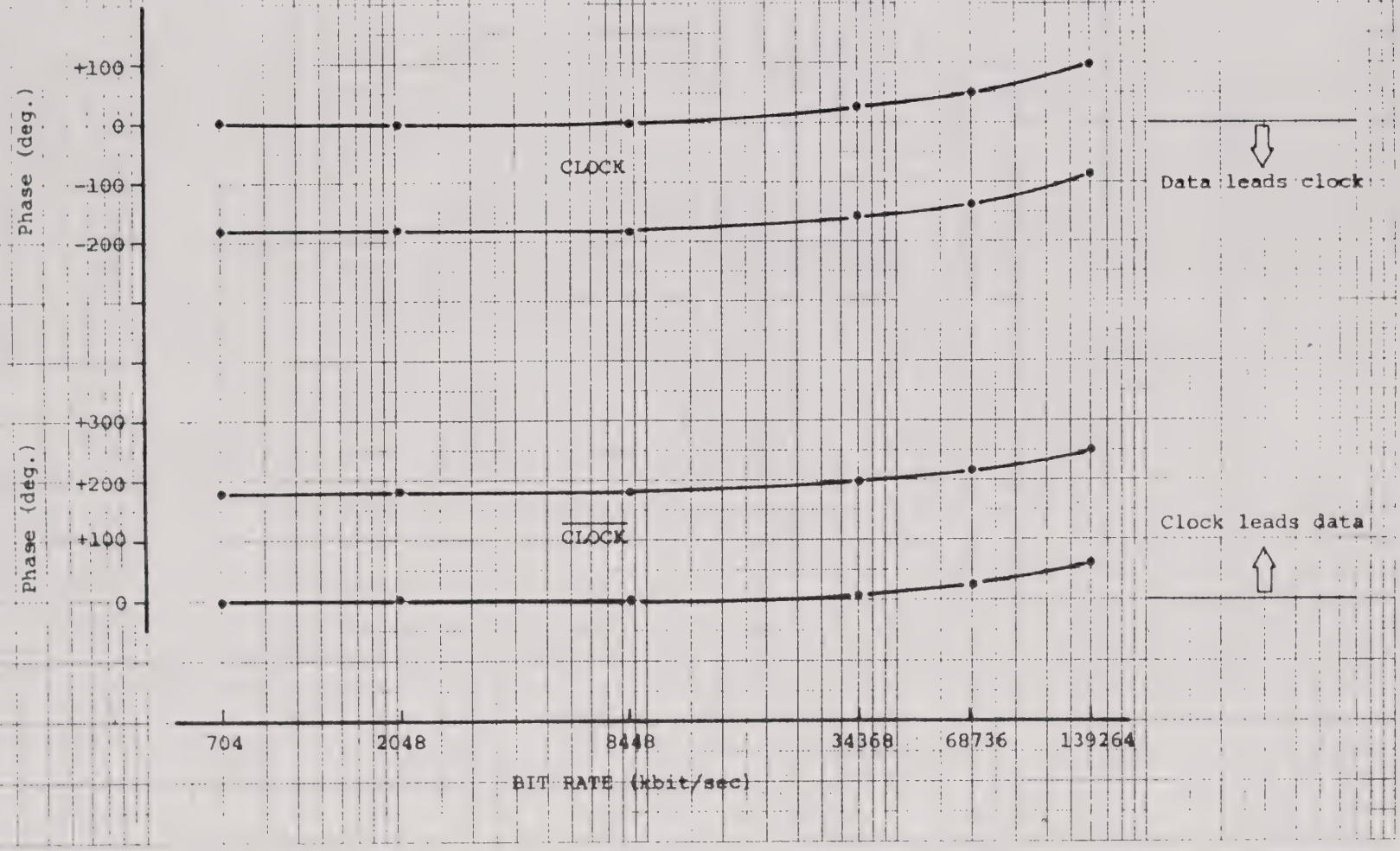
MONTH / DATE	HOUR MINUTE SECOND	Unavlbl Seconds %	Severely Errored Seconds %	Degraded Minutes 1min. %	Errored Seconds %	Error Free Seconds %	B.E.R	WORST B.E.R 1 SEC
GATING-TIME 2h0m								
01/17	22:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/18	00:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/18	02:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/18	04:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/18	06:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/18	08:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/18	10:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/18	12:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/18	14:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/18	16:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/18	18:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/18	20:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
24hour								
01/18	20:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
GATING-TIME 2h0m								
01/18	22:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/19	00:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/19	02:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/19	04:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/19	06:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/19	08:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/19	10:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/19	12:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.02E-02
01/19	14:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/19	16:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/19	18:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/19	20:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
24hour								
01/19	20:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.02E-02
GATING-TIME 2h0m								
01/19	22:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/20	00:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/20	02:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/20	04:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.02E-02
01/20	06:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/20	08:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/20	10:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/20	12:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02
01/20	14:35:32	10.0000	11.1111	66.6666	34.4444	65.5556	1.11E-03	1.00E-02

Fig. 3-29 ME520B RECEIVER
NRZ INPUT Static Phase Tolerance
(Typical data)



(See paragraph 3.4.3)

Fig. 3-30 ME520B RECEIVER
RZ INPUT Static Phase Tolerance
(Typical data)



(See paratraph 3.4.3)

SECTION 4

PRINCIPLE OF OPERATION

4.1 Transmitter Operation Principle

The ME520B Transmitter block diagram is shown in Fig. 4-1.

The Z2 CLOCK circuit generates clock signals.

The Z3 PATTERN GENERATOR circuit uses these clock signals to generate PRBS or the arbitrarily set words. The Z5 OUTPUT circuit encodes, amplifies and outputs the NRZ format patterns generated in Z3.

The Z1 CPU circuit controls these circuits to the state preset at the front panel and displays the state on the Z6 DISPLAY. It also exchanges data externally through the Z9 GP-IB circuit and controls the GP-IB.

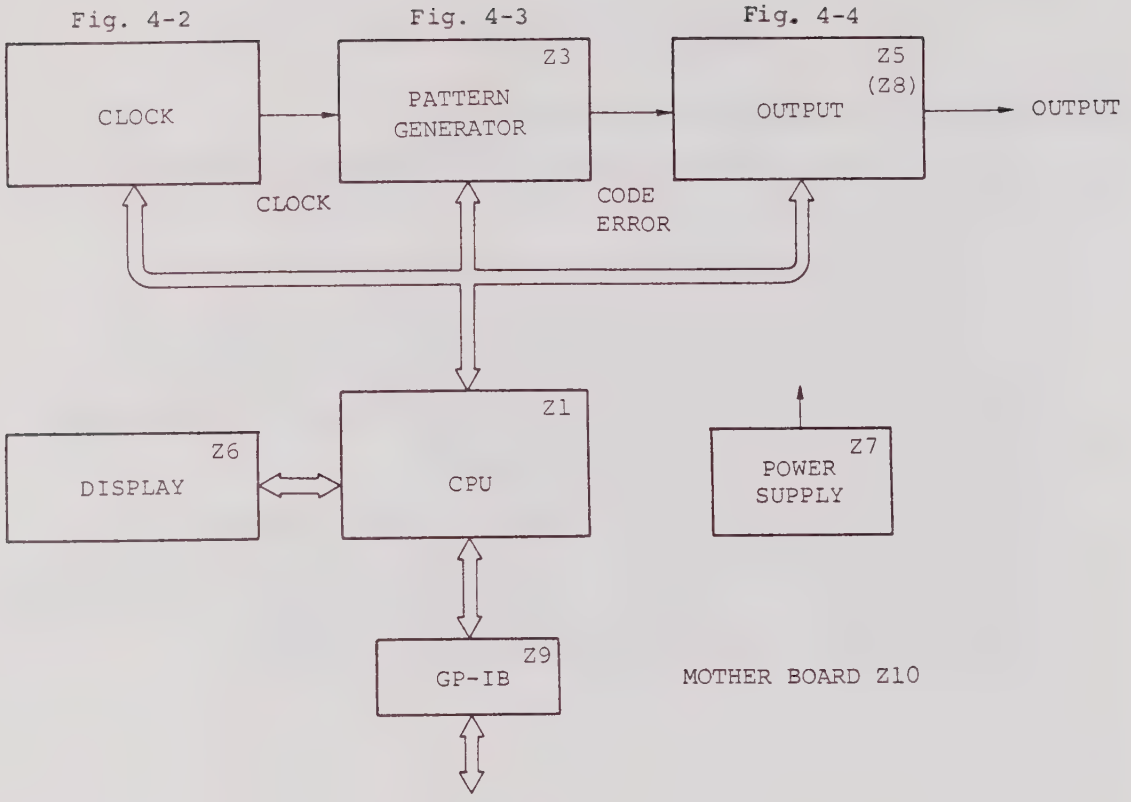


Fig. 4-1 ME520B Transmitter Block Diagram

4.2 Receiver Operation Principle

The ME520B Receiver Block Diagram is shown in Fig. 4-2.

The received input data is amplified and waveform-shaped by the Z4 INPUT circuit and is decoded as NRZ data by the Z5 and Z6 DECODERS. Subsequently, errors are detected in Z7 and Z8 ERROR DETECTORS.

On the other hand, clock signals are regenerated by the clock recovery circuit. The input jitter elements are changed to the jitter of recovered clock signal, detected, and then converted to digital data by A/D conversion.

The detected errors and jitter are counted by the Z11 COUNTER circuit and are calculated or processed by the Z12 CPU circuit.

The CPU circuit also controls all circuits, except for the Z16 POWER SUPPLY circuit, in the state preset at the front panel and displays the state and processing results on the Z14 DISPLAY.

In addition, the CPU circuit exchanges data externally and controls the GP-IB through the Z15 GP-IB circuit.

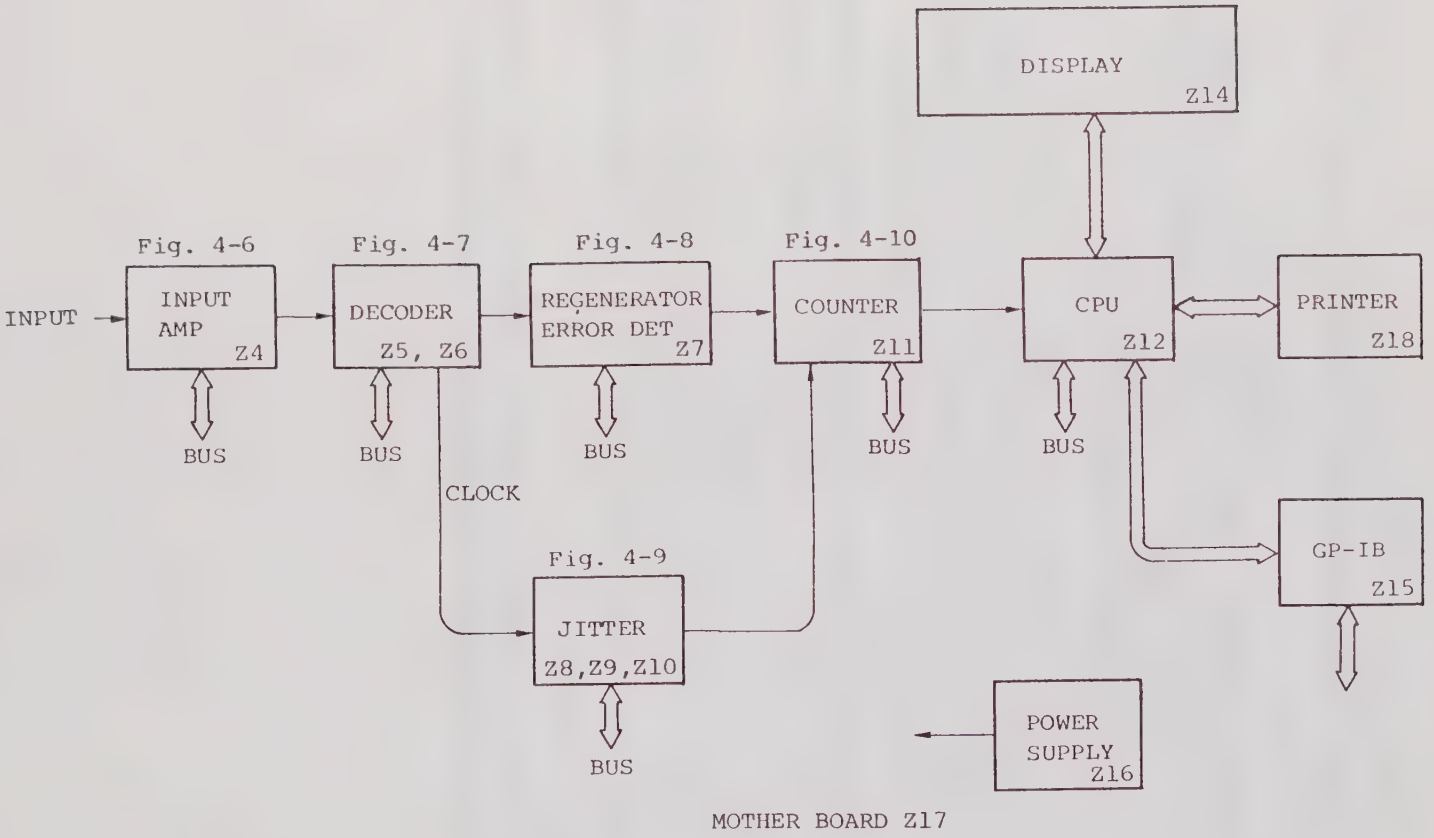


Fig. 4-2 ME520B Receiver Block Diagram

4.3 Bit Error and Code Error Detection

4.3.1 PRBS Bit Error Detection

When PRBS asynchronization is detected, the input data is input to the receiver shift register. A reference pattern is output by a sequence synchronized with the input data.

When this reference pattern is compared with the input data and no-error state for 32 bits term is confirmed, the synchronized state is assumed. Then the input data is separated, and the PRBS loop is closed. The reference pattern continues running while the synchronization state is held. Errors are detected by comparing the input data and the reference pattern bit-by-bit.

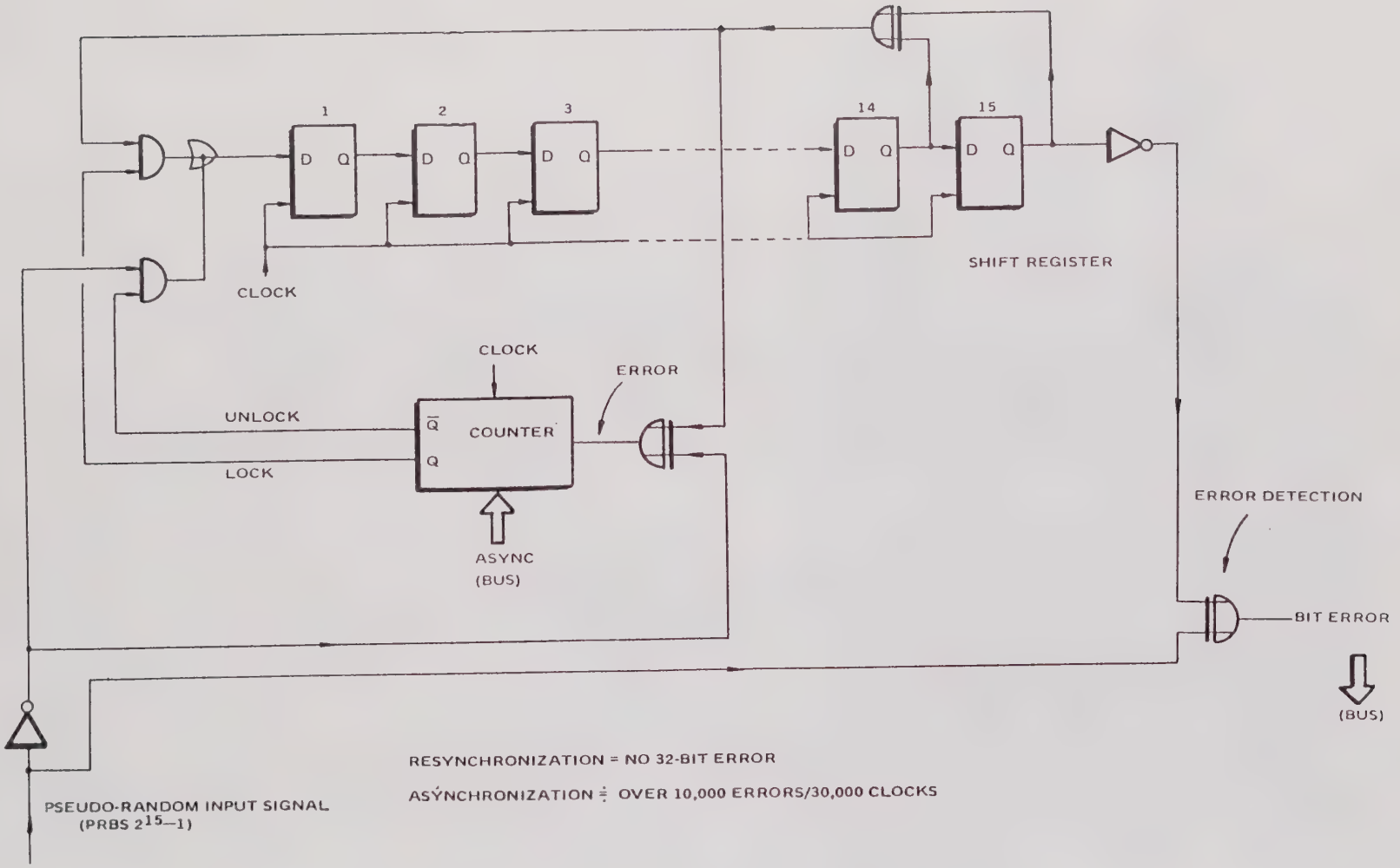


Fig. 4-3 PRBS Bit Error Detector Block Diagram

4.3.2 WORD Bit Error Detection

The preset WORD is assigned to the multiplexer data BUS, and the address data corresponding to the data-read-counter count are read sequentially. In this way the reference pattern is generated for WORD. When asynchronization is detected, the reference pattern is shifted one bit after another until synchronization is achieved. When synchronization is achieved after repeating this action, the shift is stopped and the reference pattern continues running. Errors are detected by comparing the input data and the reference pattern bit-by-bit.

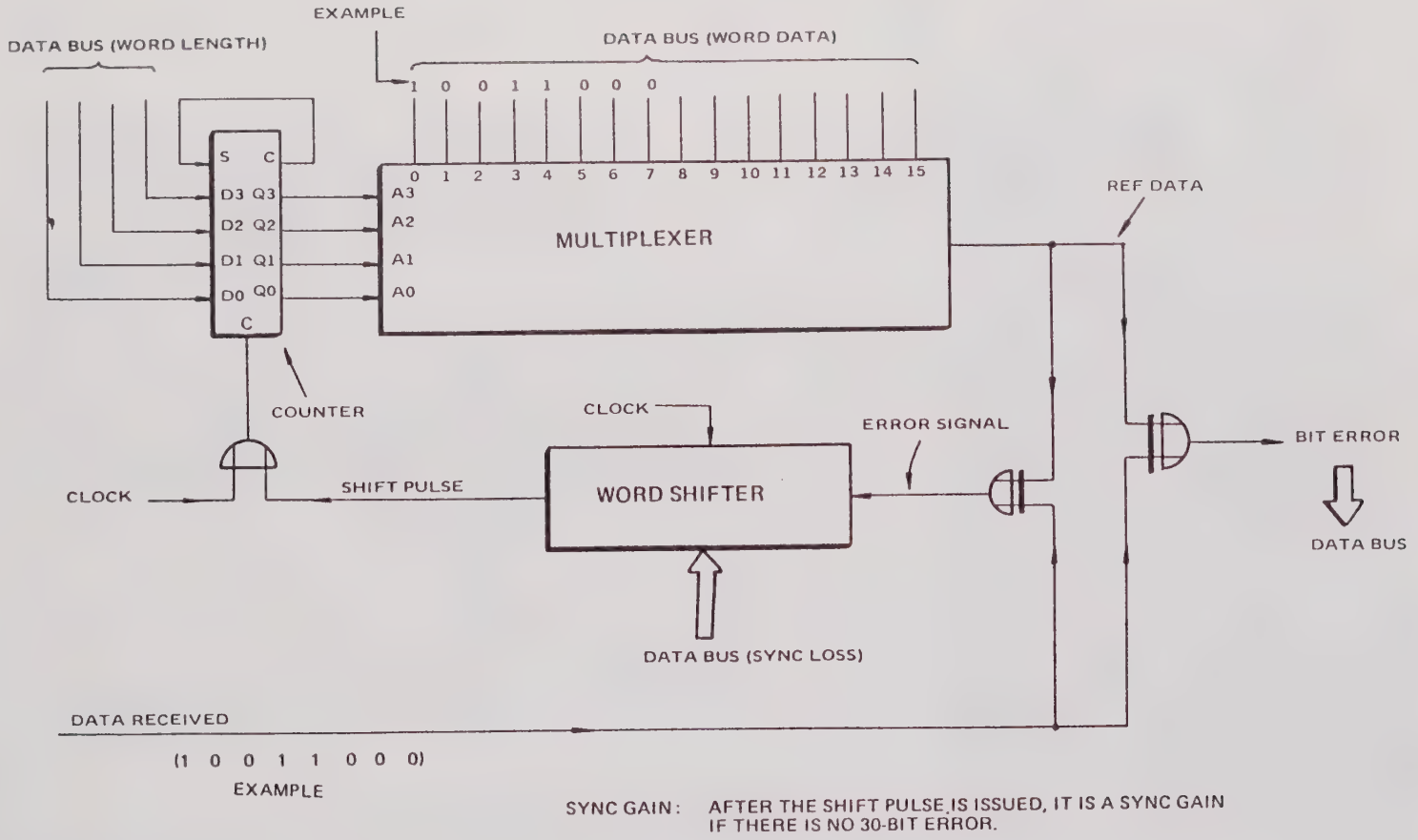
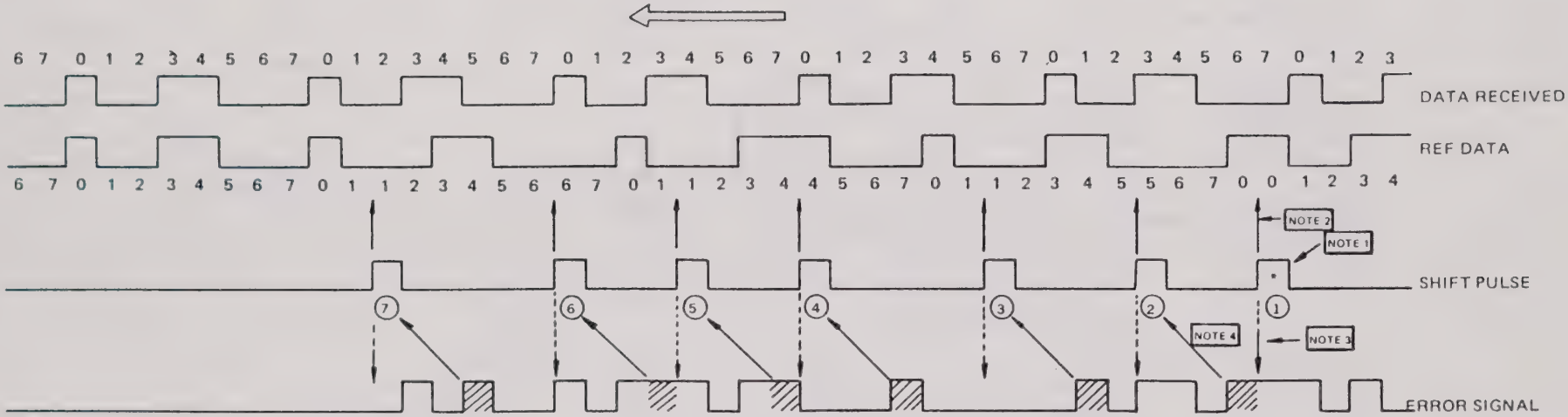


Fig. 4-4 Word Bit Error Detector Block Diagram



NOTE 1 • Starts the word by way of the data bus from the CPU. (Outputs one shift pulse with the SYNC LOSS signal.)

NOTE 2 The multiplexer address does not change with the shift pulse. (The counter does not change to stop one clock.)

NOTE 3 Outputs one error signal input first after the shift pulse issued. (Shaded portion)

NOTE 4 The error signal described above is delayed several cycles due to the configuration of the circuit. (Shift pulse output)

Synchronized with 7 shift pulses.

Fig. 4-5 Word Sync Timing Chart

4.3.3 CMI Code Error Detection

For CMI, a binary "0" indicates a code that the former half-bit has a "L" level and the later half-bit has a "H" level. A binary "1" indicates a code that the full-bit has a "H" level or "L" level, and the full-bit "H" and "L" levels are output alternately.

When only the full-bit is noticed, and the "H" or "L" level "1" continues for two bits and more, the second and later bits are detected as a CMI code error.

In Fig. 4-6, (1) is the half-bit delay data of input data. Item (1) and the inversion of the input data are retimed at each later half-bit at the same timing by recovered clock signal. For binary "0", both (2) and (3) are set to the "L" level. For binary "1", either (2) or (3) is set to the "H" level and thereafter both (2) and (3) are alternately set to the "H" level whenever "1" is input. The input marked by "E" on the chart is not inverted, so "1" continues in data (3).

A CMI code error is detected by detecting this continuation of binary "1".

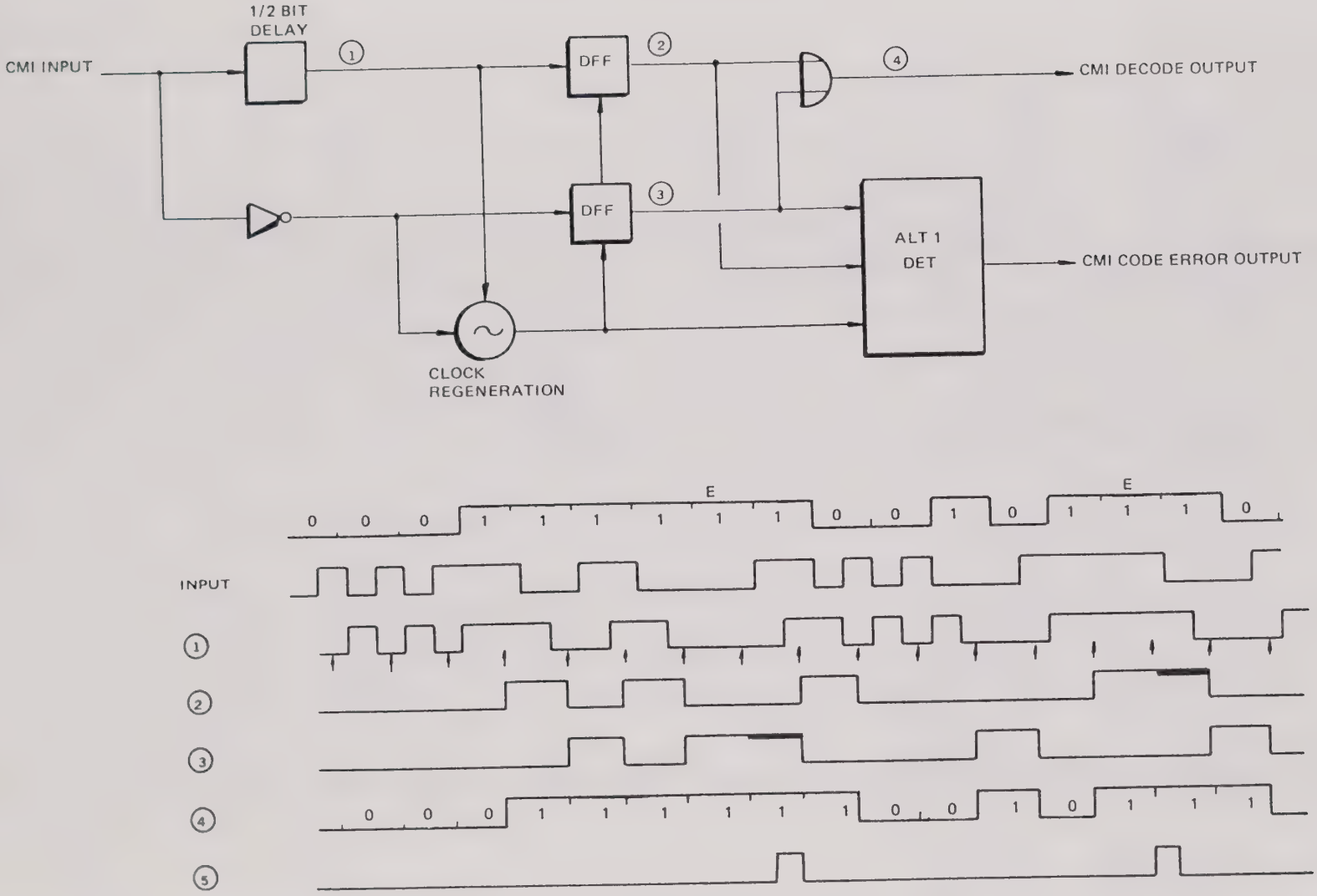


Fig. 4-6 CMI Code Error Detecting Chart

4.3.4 AMI Code Error Detection

A binary "1" indicates that the polarity is alternately inverted to positive or negative for AMI. When the polarity is checked and an "1" with the same polarity continues for two bits or more, the second and later bits are detected as an AMI code error.

In Fig. 4-7, data ① and ② are obtained by extracting the positive and negative bits of input data respectively, and converting them to NRZ. An AMI code error is detected by detecting the continuation of binary "1" of data ① and ②.

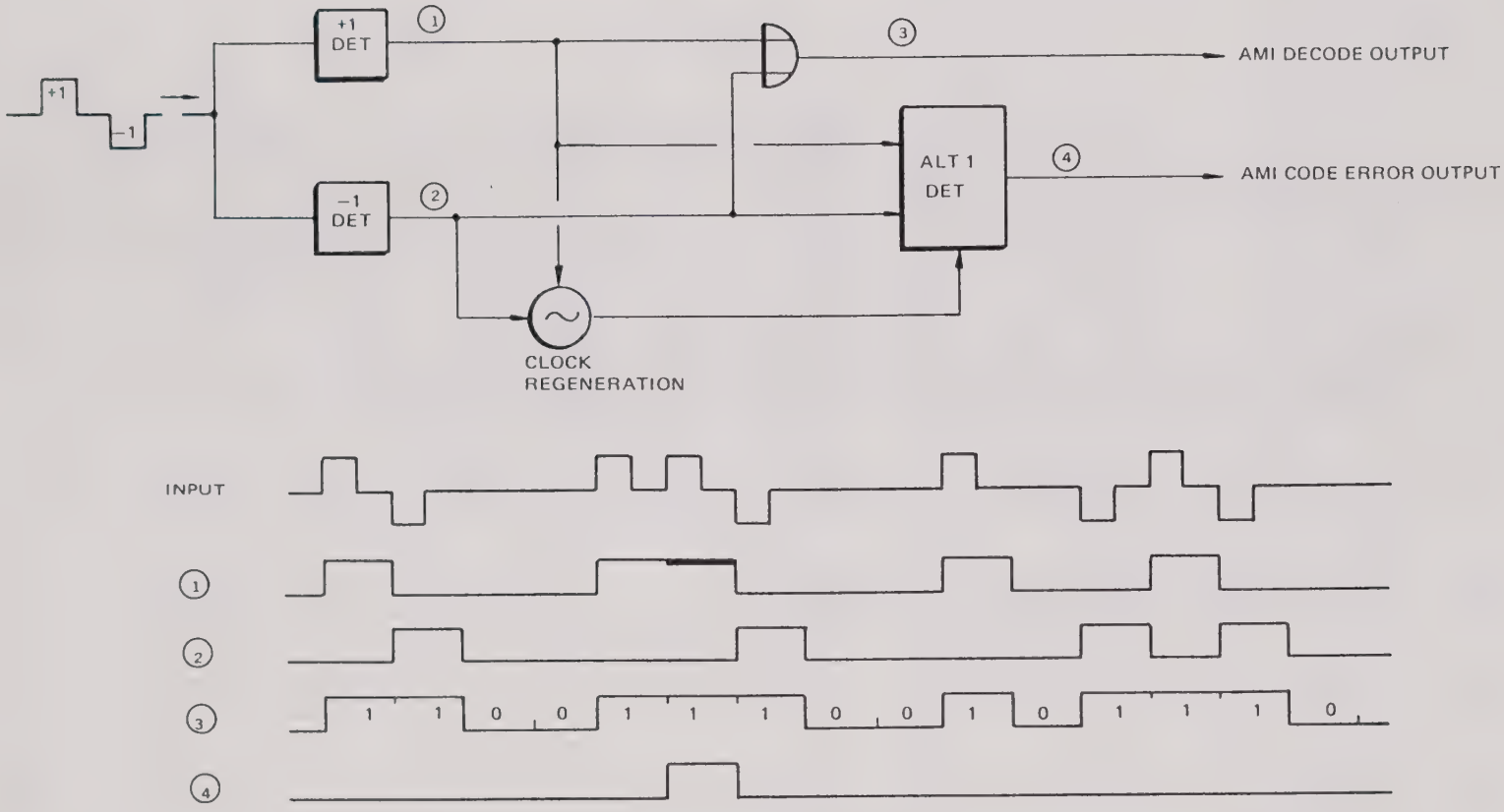


Fig. 4-7 AMI Code Error Chart

4.3.5 HDB3 Code Error Detection

HDB3 is a coding system in which a four-bit consecutive "0" section is substituted with "B00V" or "000V" patterns to the AMI coding. When the "V" (violation) bit is noticed and a V-bit with the same polarity continues for two bits or more, the second and later bits are detected as an HDB3 code error.

In Fig. 4-8, data ① and ② are obtained by extracting the positive and negative bits of input data respectively, and converting them to NRZ. Data ③ is obtained by extracting the "+V" bit from data ①, and data ④ is obtained by extracting the "-V" bit from data ②. The extracted "V" bits are alternately generated in data ③ and ④.

An HDB3 code error is detected, by detecting the continuation of the "V" bits of data ③ and ④.

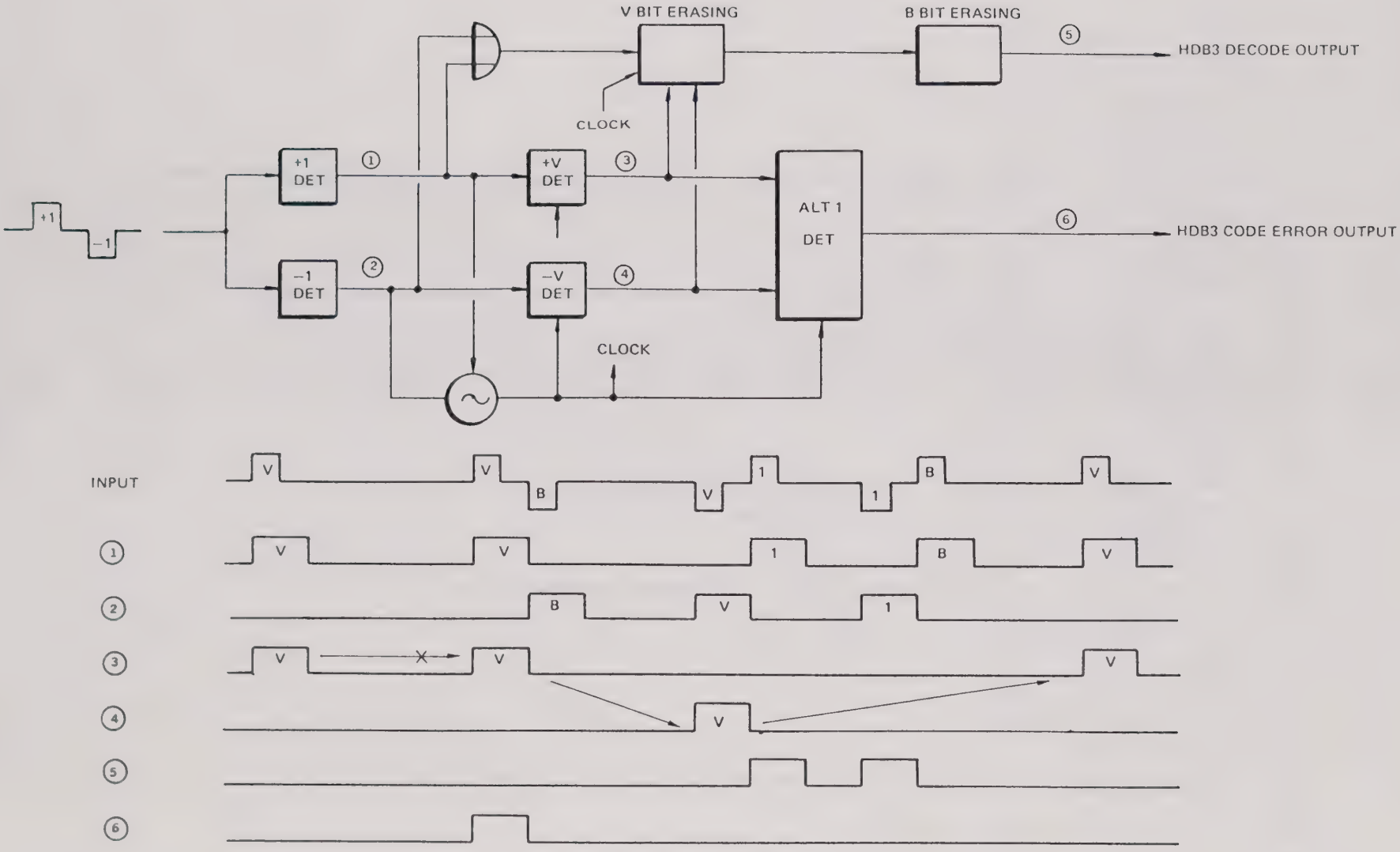
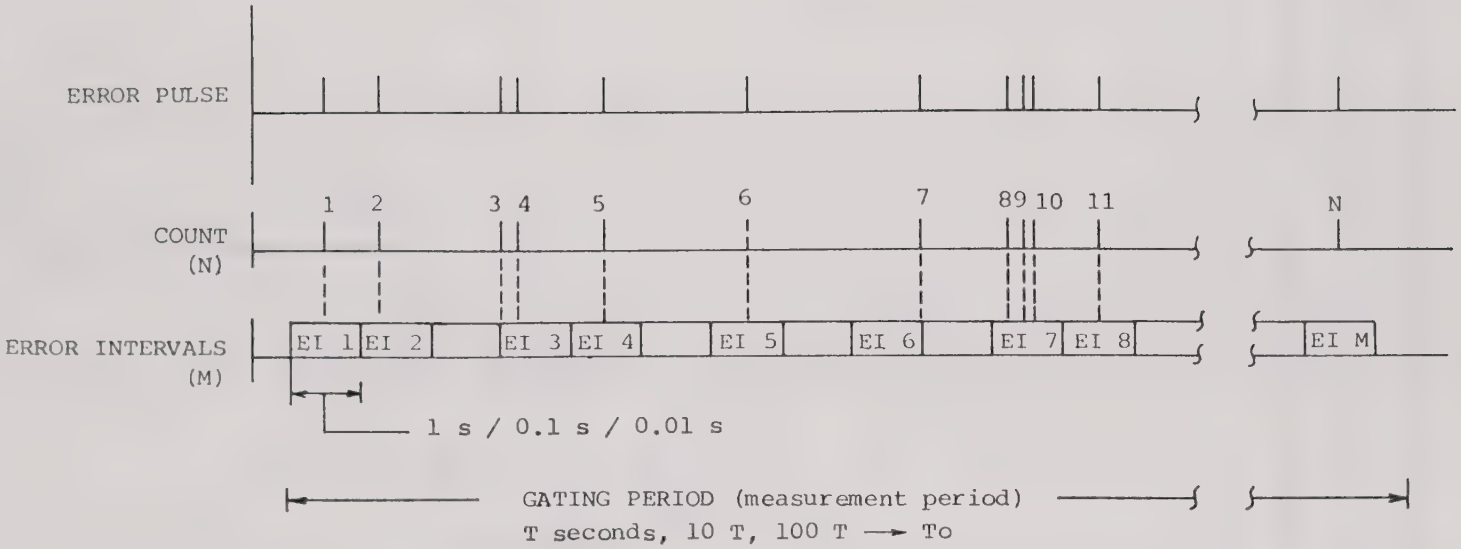


Fig. 4-8 HDB3 Code Error Chart

4.4 Error Count and Error Interval Measurement

Error pulses are counted directly for the error count. In the error interval measurement, the measurement period is divided into preset intervals, and the presence of errors in each interval is determined. The number of error intervals is the total of intervals in which there are errors.

The number of error-free intervals is the total of intervals in which there are no error.



$$\text{ERROR FREE INTERVAL \%} = \frac{To - M}{To} \times 100\ (\%)$$

(Error timing and interval timing are asynchronous.)

Fig. 4-9 Error Count and Error Interval Timing Chart

4.5 Jitter-Hit Detection

The jitter hit is detected by presetting the jitter hit threshold and comparing the jitter amplitude with the threshold level. For the hit count, both the positive and negative hit pulses are totaled and sent to the counter.

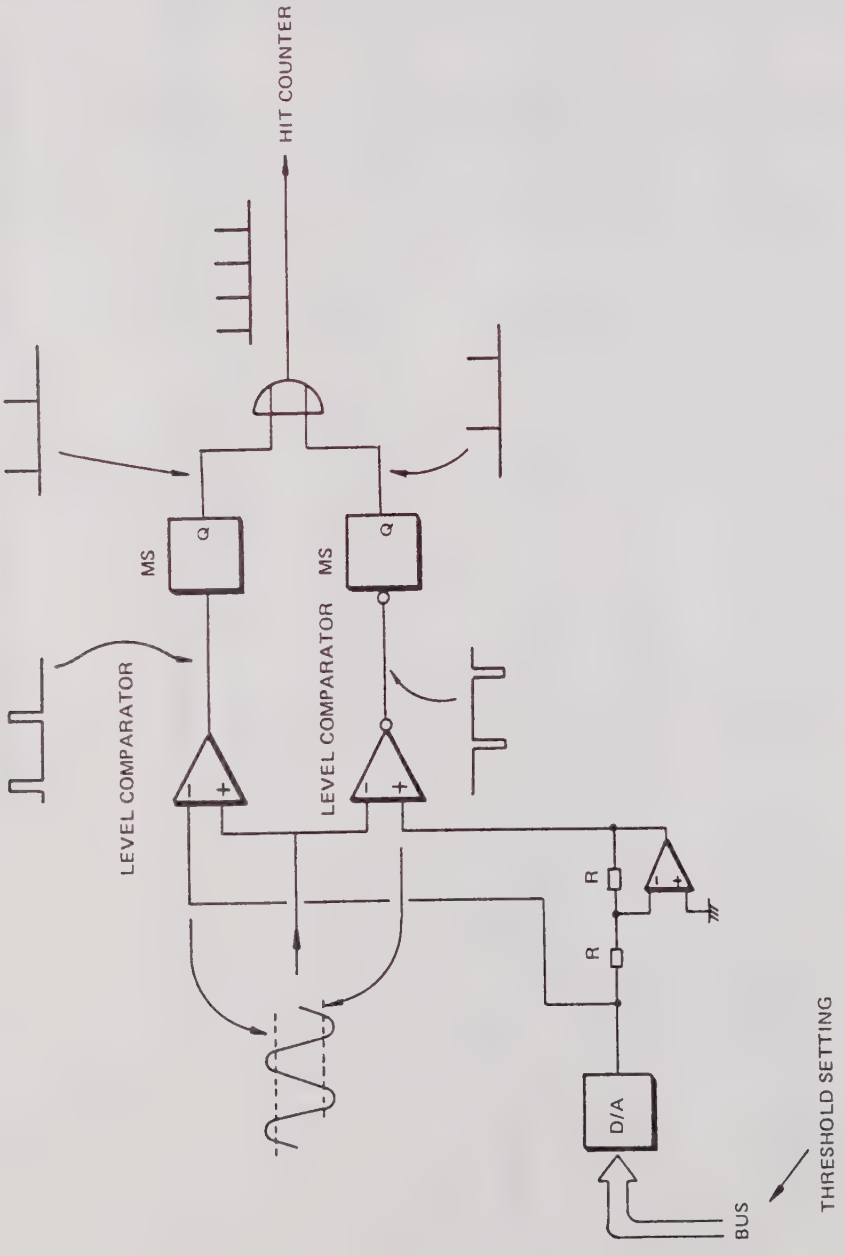


Fig. 4-10 Jitter Hit Detector Circuit

4.6 Jitter-Hit and Jitter-Hit Interval Measurement

Hit pulses are counted directly for the hit count. In the hit interval measurement, the measurement period is divided into preset intervals, and the presence of hits in each interval is determined. The number of hit intervals is the total of intervals in which there are hits. The number of hit-free intervals is the total of intervals in which there are no hit.

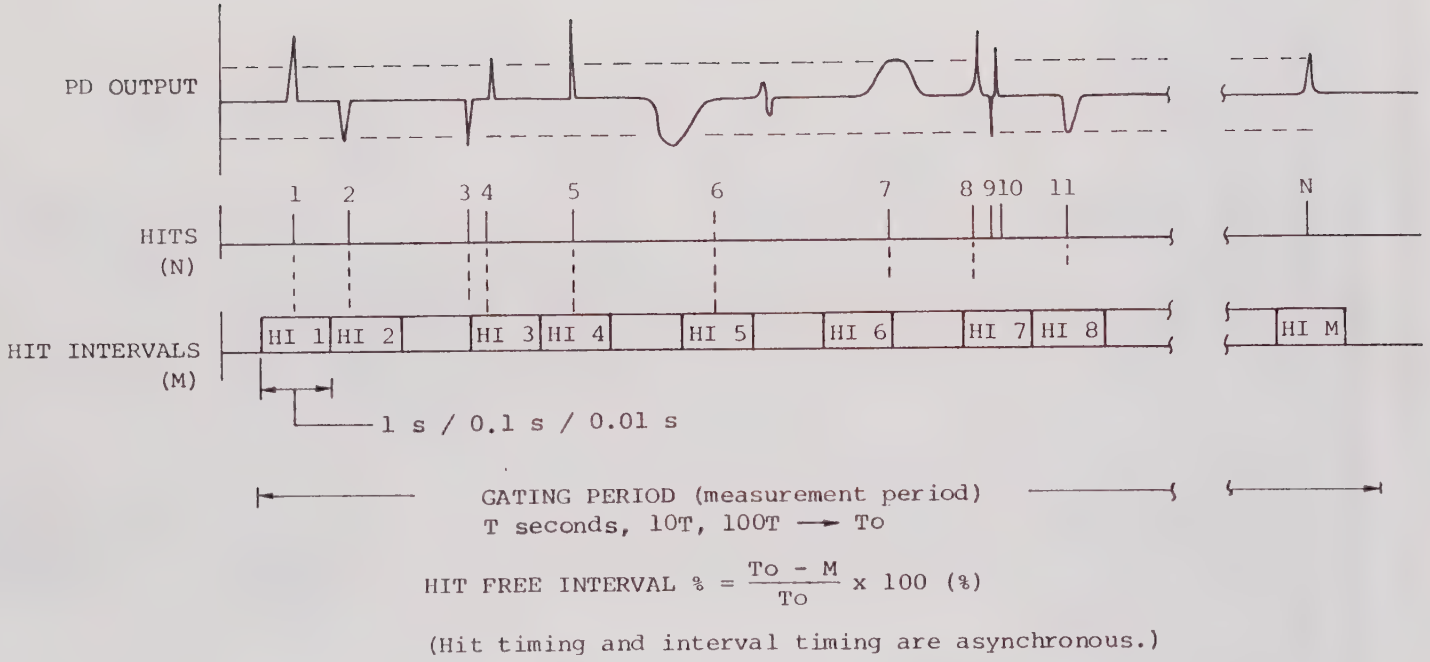

PD OUTPUT
HITS
(N)
1 2 3 4 5 6 7 8 9 10 11 N
HIT INTERVALS
(M)
HI 1 HI 2 HI 3 HI 4 HI 5 HI 6 HI 7 HI 8 HI M
1 s / 0.1 s / 0.01 s
GATING PERIOD (measurement period)
T seconds, 10T, 100T → To
HIT FREE INTERVAL % = (To - M) / To x 100 (%)
(Hit timing and interval timing are asynchronous.)

Fig. 4-11 Jitter Hit and Jitter Hit Interval Timing Chart

SECTION 5

GP-IB INTERFACE

5.1 General

The GP-IB Interface of the Digital Transmission Analyzer ME520B is an interface bus based on Recommendation IEEE-488.

5.2 Outline of GP-IB System

The GP-IB system electrically and mechanically standardizes the interface section for devices with multiple functions and connects them to one bus line. All data transfer between devices is performed via this bus line.

5.2.1 Outline

The block diagram of the GP-IB system is shown in Fig. 5-1.

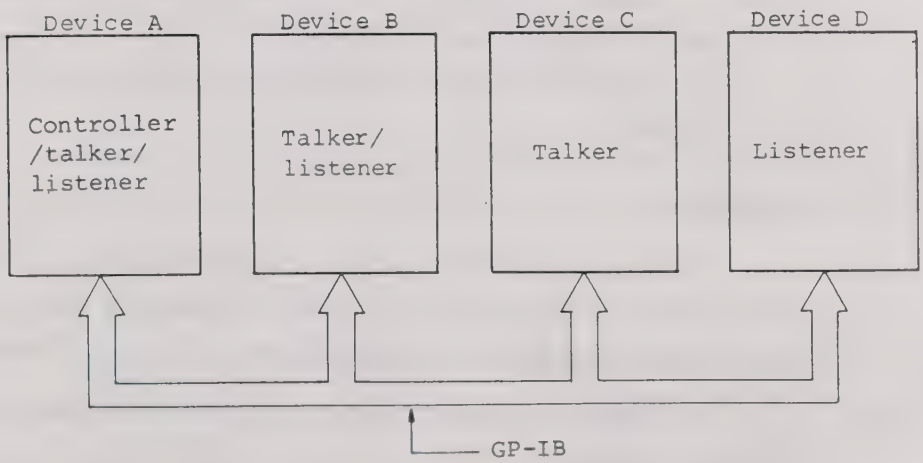


Fig. 5-1 GP-IB System Block Diagram

Figure 5-1 shows four devices, however, this interface bus system can connect up to 15 devices. The functions of these devices is grouped into the three types shown below. Each device can belong to any of these groups.

(1) Controller

This device controls the entire system. Generally, a computer or calculator is given this function. The controller has the ability to designate itself and other devices as listener or talker.

Two or more controllers can connect to one bus system. However, only one controller can operate at one time.

The ME520B Receiver has the controller function in the address 0 mode. At this time, only the address 0 of the ME520B Transmitter can be connected to the GP-IB bus.

(2) Talker

This is a device which has the ability to send data to other devices. This function is effective only when the device is designated as a talker. Two or more talkers cannot operate simultaneously in one bus system.

(3) Listener

This is a device which has the ability to receive data from other devices. This function is effective only when the device is designated as a listener.

Several listeners may operate simultaneously in one bus system.

The three system components have been described separately above but actual devices often have all these functions. For example, a calculator has controller, talker, and listener functions and performs these functions as is appropriate.

5.2.2 Bus line descriptions

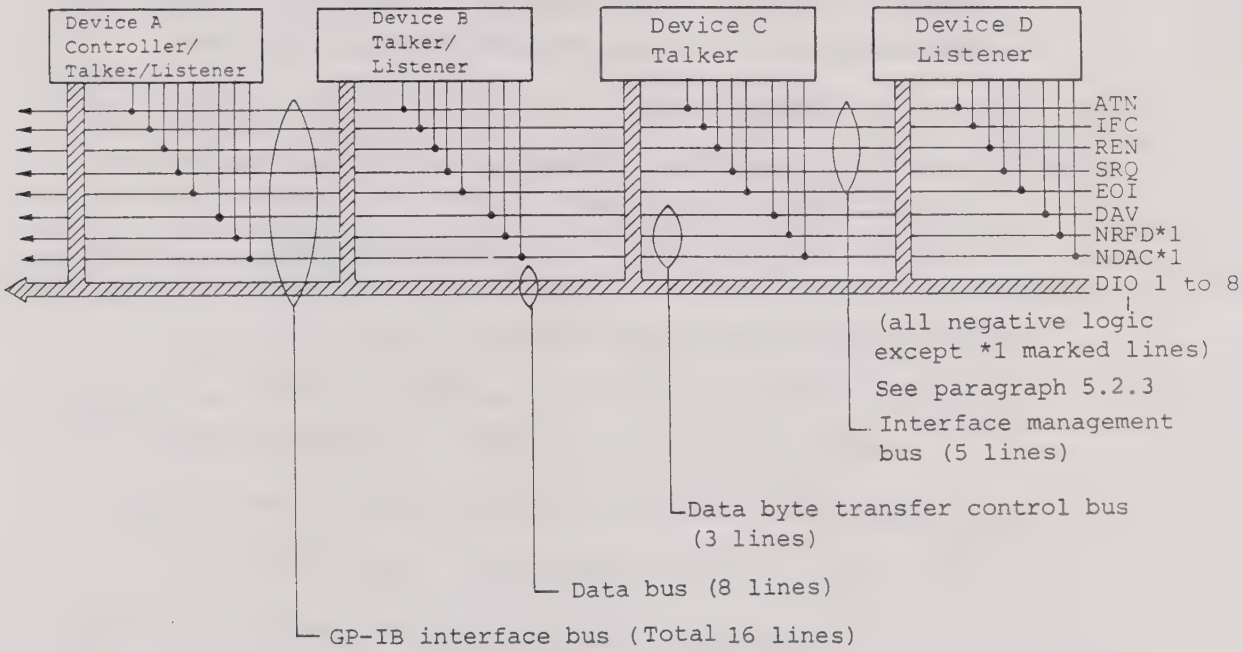


Fig. 5-2 Bus Line Composition

The bus is made up of 16 signal lines as shown in Fig. 5-2, and is classified into the following three functional groups:

(1) Data bus (DIO 1 to DIO 8)

This bus consists of 8 signal lines and is used for transferring data between devices and for sending commands from the controller to other devices.

Data and commands are transferred in bit parallel and byte serial format.

(2) Data byte transfer control bus (DAV, NRFD, NDAC)

This bus consists of 3 signal lines. It is the signal line for secure transfer when messages on the data bus, output by the talker, are sent to the listeners.

The process by which data are transferred by these 3 signal lines is called "three-wire handshake". The signal lines have the following functions:

(a) DAV (Data Valid)

This line indicates that the data on the data bus are valid.

The controller or talker controls this line.

(b) NRFD (Not Ready For Data)

This line indicates that the listener is not ready to receive the data on the data bus.

The listener controls this line.

(c) NDAC (Not Data Accepted)

This line indicates that the listener has not yet accepted the data on the data bus.

The listener controls this line.

(3) Interface management bus (ATN, IFC, REN, SRQ, EOI)

This bus consists of 5 signal lines, and is associated with various controls of the entire bus system.

The signal lines have the following functions:

(a) ATN (Attention)

This line is controlled by the controller, and discriminates the meaning of the data on the data bus. (Command or address and data discrimination)

When this line is TRUE, the data on the data bus are an address or command, and all the devices must participate in the three-wire handshake and receive the data.

When this line is FALSE, the data on the data bus are general data, and only the designated devices (that is the addressed devices) participate in the three-wire handshake and transfer data. At this time, the other devices are unrelated to operation.

(b) IFC (Interface Clear)

This line initializes each device. It is controlled by the controller.

(c) REN (Remote Enable)

This line is controlled by the controller, and is used with other messages (commands) to control whether the devices are made remote or local.

(d) SRQ (Service Request)

This line is used when a device generates an interruption to the controller.

(e) EOI (End of Identify)

This line is used to indicate the end of transfer of several byte data, and is controlled by the talker.

5.2.3 Three-wire Handshake

The use of the 3 lines DAV, NRFD, and NDAC as a method of data and command transfer between devices has already been mentioned. The relationship between these 3 lines and the data bus is shown in Figs. 5-3 (timing chart) and 5-4 (flowchart). The GP-IB bus theory and signal names are described here and should be noted when reading Figs. 5-3 and 5-4.

All the GP-IB bus is negative logic. That is, LOW level means "signal present". For example, when DAV (Data Valid) has become LOW level, it indicates that the data to be transferred have been placed on the bus line.

(Note*1) However, of the 16 signals, only NRFD (Not Ready For Data) and NDAC (Not Data Accepted) are functionally positive logic.

When NRFD is HIGH level, RFD (Ready For Data) indicates that the device is ready to receive data. Therefore, if this is considered negative logic, when LOW level, it has a negative meaning at RFD as a line function. So it becomes "Not Ready For Data" (NRFD).

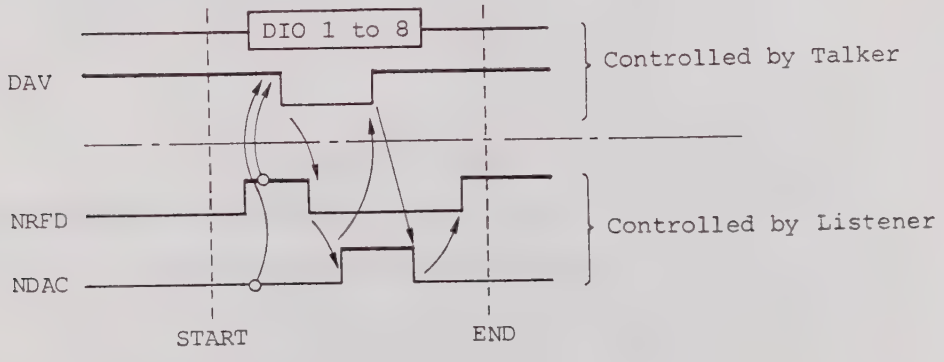
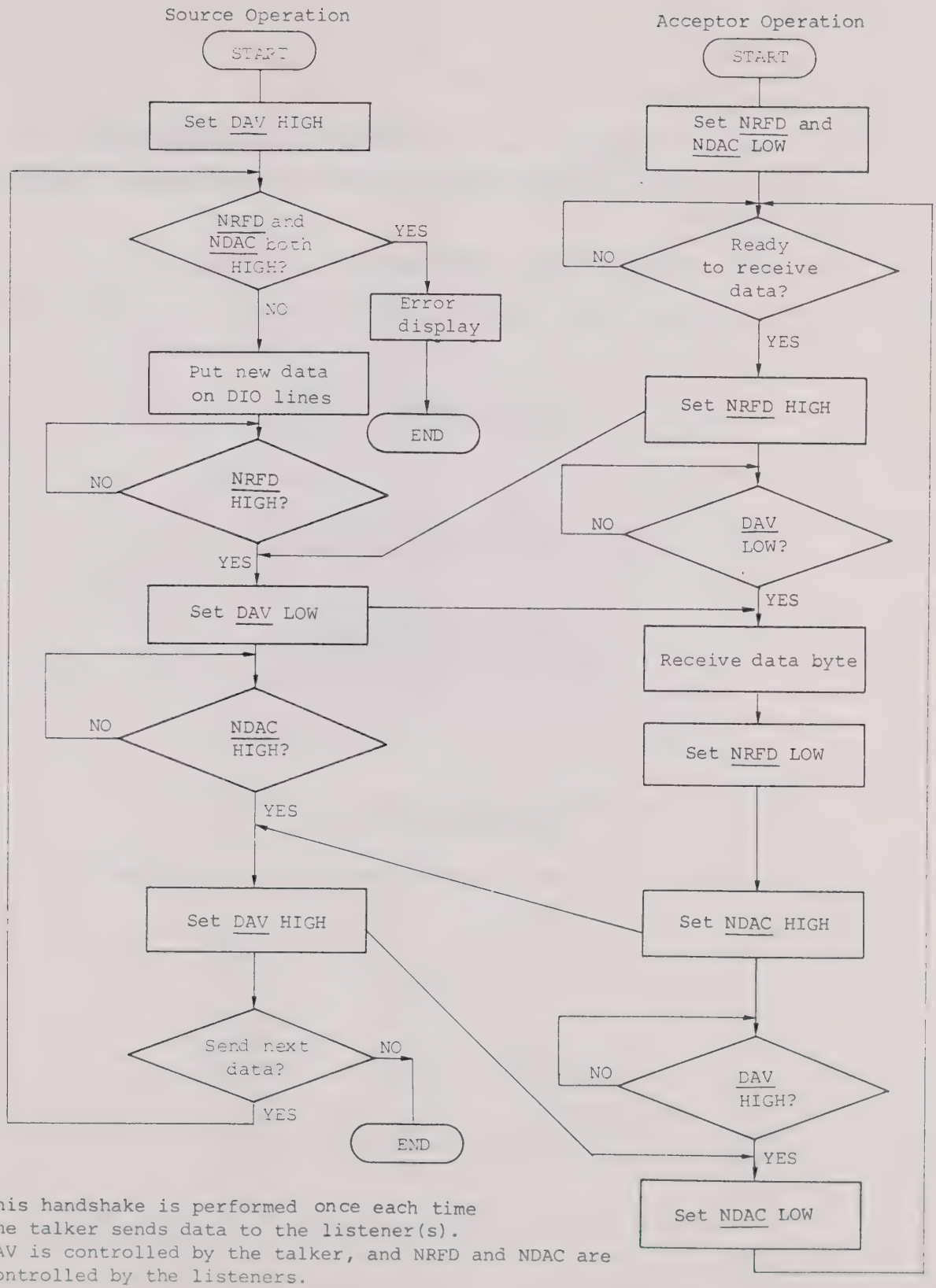


Fig. 5-3 Three-wire Handshake Timing Chart



This handshake is performed once each time the talker sends data to the listener(s). DAV is controlled by the talker, and NRFD and NDAC are controlled by the listeners.

Fig. 5-4 Three-wire Handshake Flowchart

5.2.4 Cable connections

Up to 15 devices can connect to this GP-IB system. However, note that the connection cable lengths are limited as follows:

(1) The length of each cable must be $\leq$ 2 m.

(2) The total cable length must be $\leq$ 20 m.

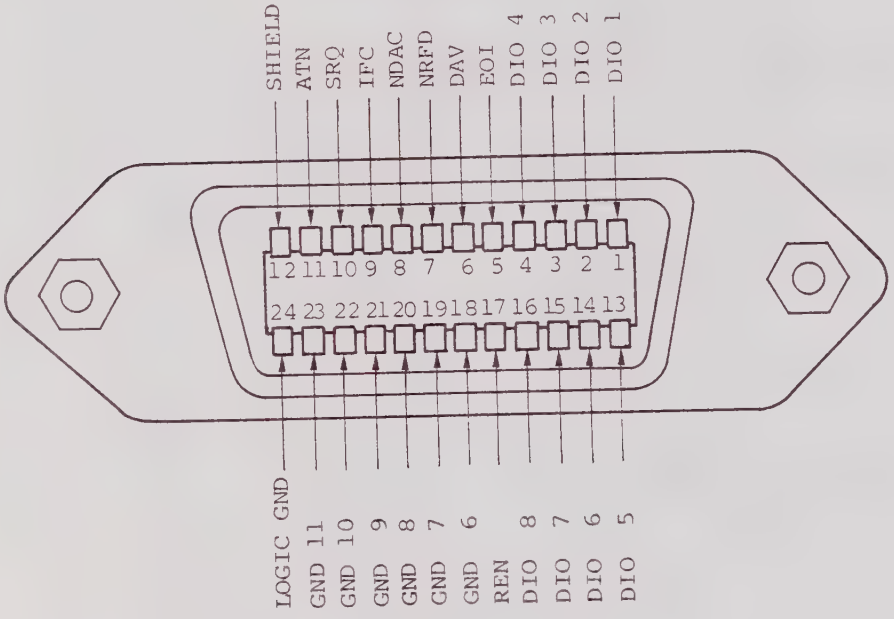


Fig. 5-5 GP-IB Interface Connector Pin Assignment

5.3 Measurement Preparations

A connection example is shown in Fig. 5-6.

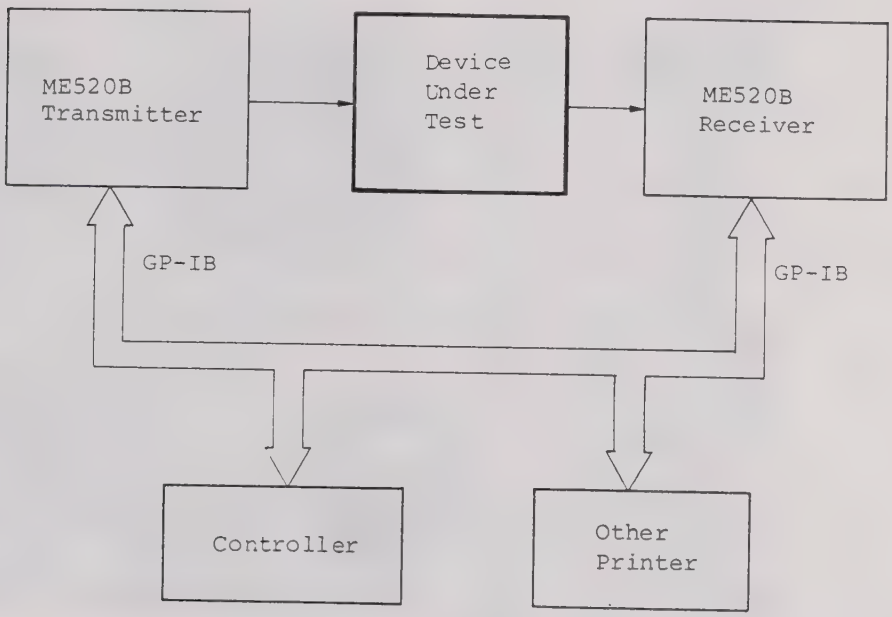


Fig. 5-6 GP-IB Interface Configuration

5.3.1 GP-IB ADDRESS setting

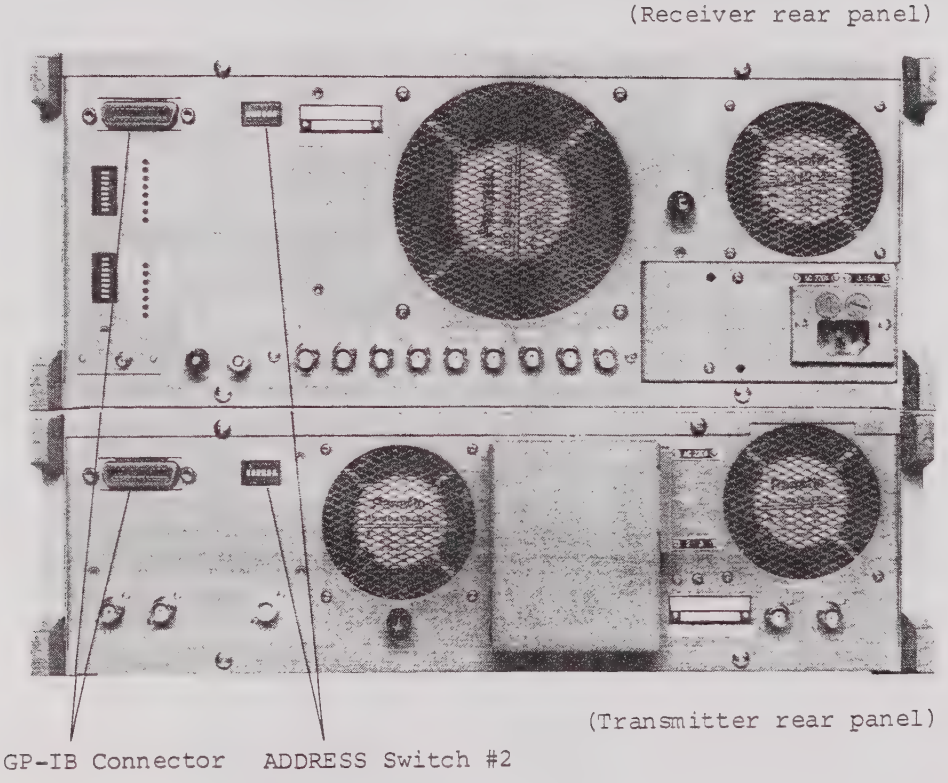


Fig. 5-7 Rear Panel Address Setting

When the GP-IB function of a measuring instrument is used, address setting is necessary. The addresses of the ME520B Transmitter/Receiver are set with switch #2 shown in Fig. 5-7.

When the power is turned on, the ME520B operates in the modes shown in Tables 5-1 and 5-2 according to the switch setting.

Table 5-1 Transmitter Address Setting

Mode	When Power Turned On		Setting Change After Power Turned On (When GP-IB is LOCAL*1)
	TALK-ONLY	Address	
Device mode	OFF	1 to 30	Address corresponding to the address switch setting change
TALK-ONLY mode	ON	-	———
ADDRESS 0 mode	OFF	0	Invalid. Remains address 0

Table 5-2 . Receiver Switch Setting

Mode	When Power Turned On		Setting change after Power Turned On (When GP-IB is LOCAL*)
	TALK-ONLY	Address	
Device mode	OFF	1 to 30	Address corresponding to the address switch setting change
TALK-ONLY mode	ON	-	———
ADDRESS 0 mode	OFF	0	Invalid. Remains address 0 *2

*1 GP-IB REMOTE: (REMOTE lamp lit)
LOCAL : (REMOTE lamp off)

*2 Receiver works as the bus controller for data exchange with the address 0 mode of transmitter.

To set the address of the measuring instrument in the device mode, set the address switches to any value between 1 and 30 and turn on the POWER.

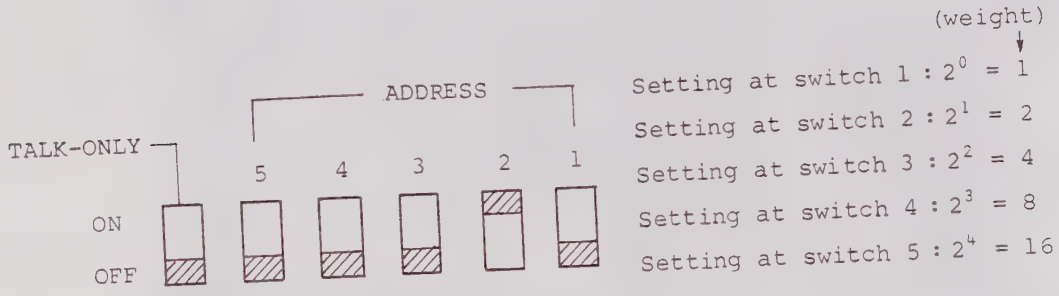


Fig. 5-8 Address Setting

The address of the address switch setting shown in Fig. 5-8 is 2.

Set the TALK ONLY switch at the right end to ON only in the TALK-ONLY mode and turn on the power. Output data to GP-IB bus in TALK ONLY mode is selected by switches R-22 (A to H).

Note:

When the ME520B receives a Device Clear command, ME520B is initialized.

After the ME520B receives a Device Clear command, a few seconds wait time prior to measurement is recommended.

5.3.2 Device modes

The ME520B operates as a device with listener/talker functions. In listener operation, the functions of all the switches except the POWER switch, GP-IB ADDRESS switch, and manual setting variable resistors, can be set through the GP-IB. In talker operation, the setting of each switch and the measured result can be read.

(1) Programming codes

All the programming codes are given in Tables 5-6 to 5-13. Do not input any other codes.
A delimiter must be added to all the codes.
Programming codes without a delimiter may be ignored or may be decoded as a different command. When one line of commands containing an illegal code is received, SRQ is activated as an alarm at the end of the line.

The alarm is updated at the end of every line.
All spaces of the input ASCII character codes are ignored. Valid character codes are characters between decimal 33 and 127 (except printer mode).

(2) Delimiter

"," (decimal 44) is used as the delimiter.
A delimiter is necessary between codes.
Even when the delimiter is received, the code received immediately before the delimiter is executed.

(3) Line terminator

CR, LF, and EOI are used at the end of a line. The three can be freely combined. Even when the line terminator is received, the command received immediately before the line terminator is executed. When the line terminator is received, the alarm is updated.

(4) Data request

When data are output as the talker, the required data must be set in the ME520B in the listener state beforehand.

(5) Data output

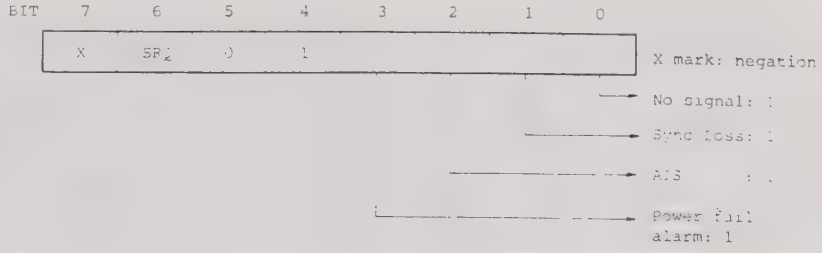
The measurement date, measured data, and switch setting conditions are output in response to a data request performed beforehand. When the device is designated a talker without a data request, only the line terminator (CR, LF/EOI) is output. When the talker designation is not released, even after there are no more requested data, the line terminator is output.

(6) Printer mode

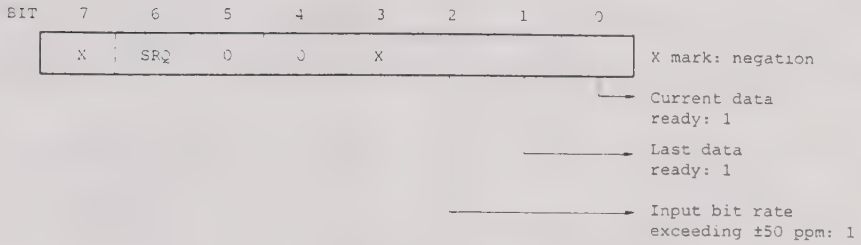
When the ME520B Receiver receives a "PL," command, it changes to the printer mode.
In the printer mode, all the data, including spaces, are passed to the optional built-in printer. That is, the delimiter and CR and LR line terminators are considered data and are passed to the printer. To exit from the printer mode, the receiver must receive EOI.

Contents of GP-IB status of the ME520B Receiver

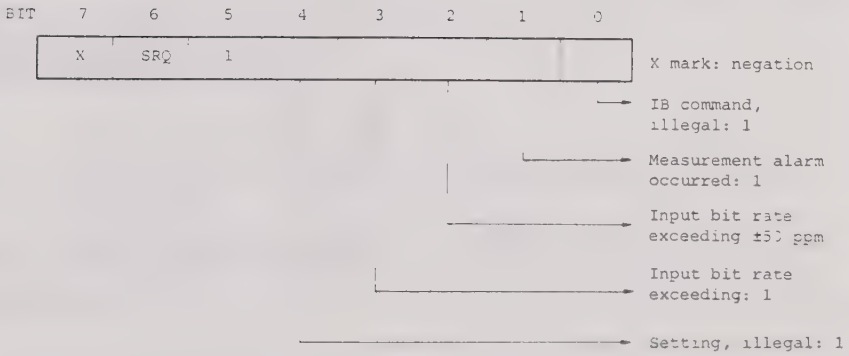
[A]



[B]



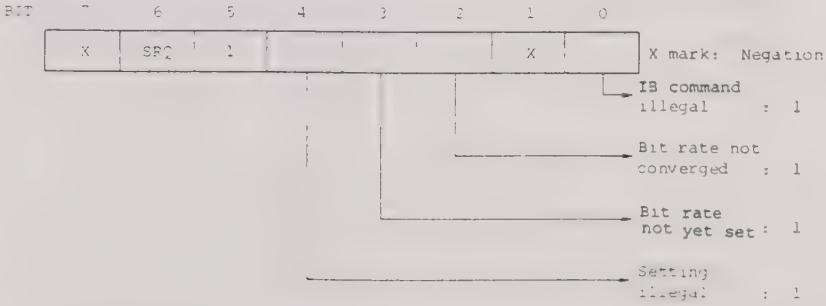
[C]


BIT 7 6 5 4 3 2 1 0
X SRQ 1
X mark: negation
IB command, illegal: 1
Measurement alarm occurred: 1
Input bit rate exceeding ±50 ppm
Input bit rate exceeding: 1
Setting, illegal: 1

In the GP-IB status of the ME520B Receiver, [A] is set continuously while each bit is processed. [B] and [C] are set when the state of each bit occurs.

Contents of GP-IB status of the ME520B Transmitter

[D]



If there is an alarm shown at each bit in the transmitter GP-IB status when a GP-IB command is received, the SRQ bit is set to 1.

5.3.3 TALK-ONLY mode

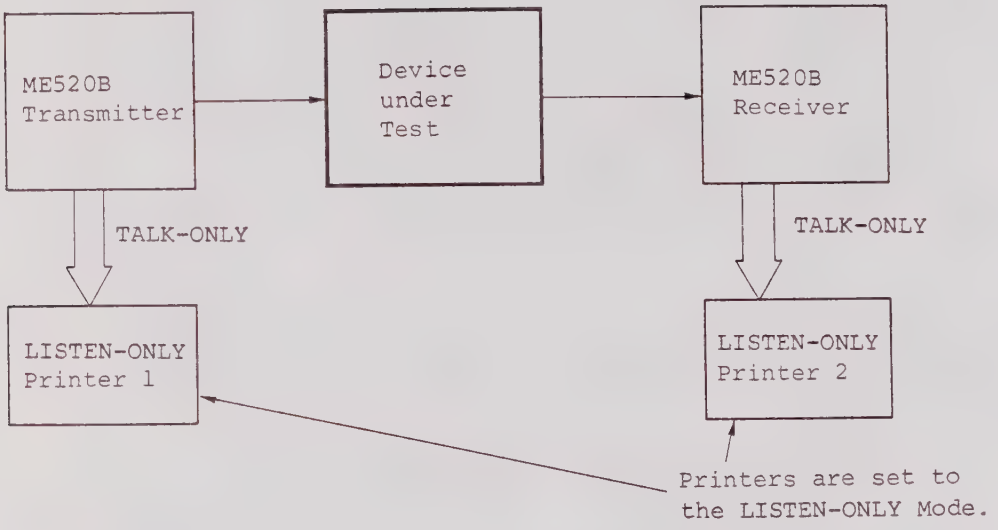


Fig. 5-10 TALK-ONLY Mode Configuration

The TALK-ONLY mode is established by making the connections shown in Fig. 5-10. It can be used for collecting the measured data.

The jitter p-p data are output from the transmitter every 0.6 s or 6 s. (Refer to paragraph 3.2.5 and 3.4.18 (1)).

The measurement conditions, current data, and final data, matched to the start and end of measurement, are output from the receiver.

5.3.4 ADDRESS 0 mode

When the power is turned on with the GP-IB address switches of the transmitter/receiver set to 0, the receiver operates as the GP-IB controller. After the power is turned on, the receiver will not enter the ADDRESS 0 mode even if the address is made 0. In this mode, another GP-IB controller (computer, etc.) must not be on the GP-IB bus.

(1) Receiver automatic setting in address 0 mode

When the front panel switches are set on the transmitter, the corresponding receiver settings are automatically made. This eliminates the need for double setting.

There are more restrictions on the combination of the setting conditions allowed at the transmitter in the ADDRESS 0 mode than in other modes. This also applies to the setting conditions allowed at the receiver.

Changing the receiver front panel settings does not change transmitter settings.

Table 5-3 Allowable Format and Bit Rate Combinations

Transmitter Setting								Receiver Setting	
Format	Bit rate 704	2048	8448	34368	68736	139264	EXT	OPTION	Format	Bit rate (704 to OPTION)
	*2	*2	*2	*1						
AMI	o	o	o	o	x	x	x		AMI	Same as Transmitter
	*2	*2	*2	*1						
HDB3	o	o	o	o	x	x	x	x	HDB3	Same as Transmitter
CMI	x	x	x	x	o	o	x	x	CMI	Same as Transmitter
NRZ	o	o	o	o	o	o	o	o	NRZ	EXT
RZ	o	o	o	o	o	o	o	o	RZ	EXT

x: alarm (blinks)

*1 For AMI and HDB3, only output level 1 V is allowed.

*2 For AMI and HDB3, only output level 2.37 V is allowed.

The same pattern (PRBS with zero substitution, 1-16 bit word) is set at the receiver and transmitter. When a 2 x 8 bit word is set at the transmitter, the receiver pattern does not change.

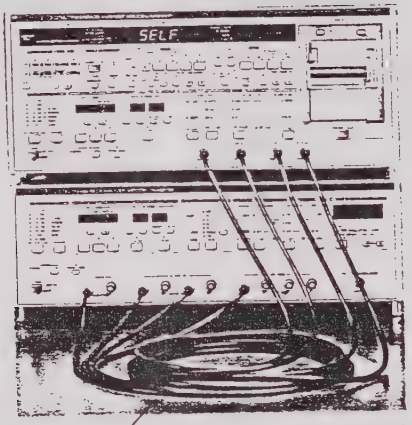
The receiver error mode (BIT, CODE) is set in the same way as the transmitter error addition mode (BIT, CODE). Changing the error addition rate at the transmitter does not change the receiver.

Table 5-4 Automatic Setting of Receiver Input by Transmitter Output

Transmitter Setting		Receiver Setting	
Transmitter Output Condition		Receiver Input Condition	
CLOCK	CLOCK	CLOCK	CLOCK
	$\overline{\text{CLOCK}}$		$\overline{\text{CLOCK}}$
	TTL		AUTO
	ECL		ECL
	SET		AUTO
NRZ/RZ	TTL	NRZ/RZ	MAN
	ECL		ECL
	SET		MAN
AMI/HDB3	2.37 V	No change at the receiver.	
	1 V		

(2) Starting of self-testing

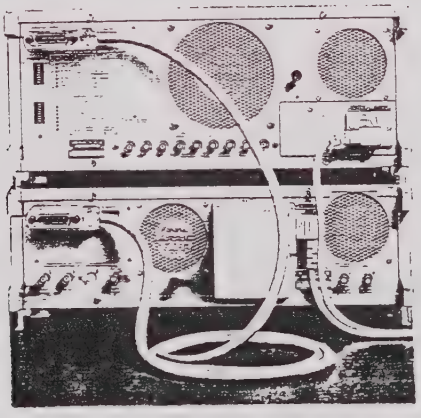
(a) Self-test preparations



(Front Side)

*

* Use coaxial cables of the same length. (Different lengths may cause time delay errors).



(Rear Side)

Fig. 5-11 Self-testing Connections

(b) Starting self-testing

Set the GP-IB address to 0. Then, turn on the receiver and transmitter power switches (address 0 mode starting).

Set the SELF TEST switch (R-23) on the rear panel of the receiver to ON.

When self-testing starts, all the receiver numeric display digits are erased and "SELF" is displayed.

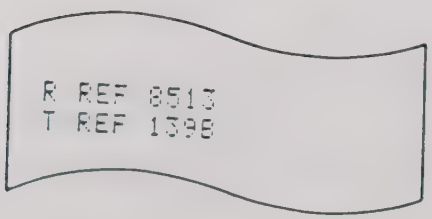
(c) Self-testing GO/NO-GO judgement

The number of self-testing measurements is 12 (13, when option frequency installed); they are shown in Table 5-5. At the end of each measurement, the quality of the measured results is judged; if the results are inaccurate, the contents are output by the receiver display and installed printer.

(d) Self-testing end

When the self-testing is completed, a bit rate and format are initialized to 704 kb/s, AMI.

When self-testing ends normally, "Pass" is displayed at the ERROR indicator (R-12), and the built-in printer (option 01) does not print out error messages; only the ROM check-thumb data of the receiver and transmitter are printed out, as shown below. (Such data is always printed out when self-testing ends normally.)



* Data printout example

(ME520B is REV. 1.1)

If an abnormality occurs during self-testing, the display when the abnormality was detected remains on display.

When self-testing is completed, turn off the self-test switch (R-23) on the rear panel; the normal mode is returned.

(e) Error display

(1) Impossible measurement

After setting each self-testing item 1 to 12, (1 to 13 when the transmitter frequency option is installed) is complete, the system waits for the cancellation of all alarm states inhibiting the start of measurement. If measurement cannot be started within approximately 60 s, an error is recognized and the measurement item number and "Err" are displayed by the display; the contents of Fig. 5-12 are printed out by the printer.

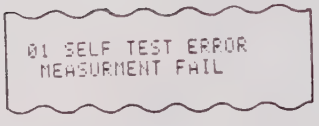


Fig. 5-12 Self-testing Alarm 1

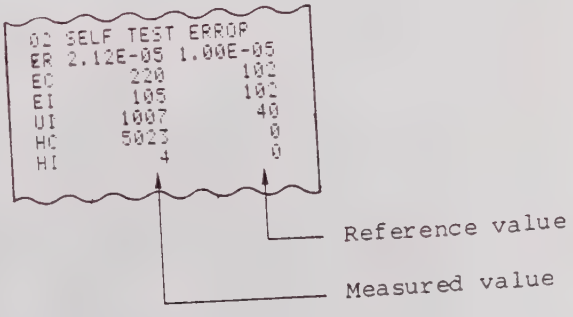


Fig. 5-13 Self-Testing Alarm 2

(ii) Inaccurate measured result

When the measured result is inaccurate, the measurement item, "Err" and the error item are displayed and contents similar to Fig. 5-13 are printed out.

Table 5-5 Self-Testing (Address 0 Mode)

Self-testing No.	To be set for both the transmitter and receiver			To be set for the transmitter				To be set for the receiver			
	BIT RATE	FORMAT	PATTERN	Error Addition MODE	Error Addition RATE	Output Clock *1	Output Data *2	Frequency Offset	Input Clock *3	Input Data *4	Gating Period	Error Error MODE
01	704 kb	AMI	PRBS $2^{10}-1$ ZERO SUB 0	CODE	10^{-6}	---	2.37 V	OFF	---	TERM	CLOCK 10^{7}	CODE
02	2048 kb	HDB3	PRBS $2^{15}-1$ ZERO SUB 120	CODE	10^{-5}	---	2.37 V	+30 ppm	---	TERM	CLOCK 10^{7}	CODE
03	8448 kb	AMI	PRBS $2^{23}-1$ ZERO SUB 24	CODE	10^{-4}	---	2.37 V	-30 ppm	---	TERM	CLOCK 10^{8}	CODE
04	34368 kb	HDB3	WORD 1-16BIT 1001 0000 0101 0000	CODE	10^{-3}	---	1 V	OFF	---	TERM	CLOCK 10^{9}	CODE
05	68736 kb	CMI	PRBS $2^{15}-1$ ZERO SUB 0	CODE	OFF	---	---	+30 ppm	---	TERM	CLOCK 10^{9}	CODE
06	139264 kb	CMI	PRBS $2^{23}-1$ ZERO SUB 120	CODE	10^{-6}	---	---	-30 ppm	---	TERM	CLOCK 10^{9}	CODE
07	704 kb *5	NRZ	PRBS $2^{23}-1$ ZERO SUB 0	BIT	10^{-6}	CLOCK TTL	ECL	+30 ppm	CLOCK AUTO	ECL	CLOCK 10^{7}	BIT
08	2048 kb *5	RZ	WORD 1-16BIT 1011 001	BIT	10^{-5}	$\overline{\text{CLOCK}}$ ECL	ECL	-30 ppm	$\overline{\text{CLOCK}}$ ECL	ECL	CLOCK 10^{7}	BIT
09	8448 kb *5	NRZ	PRBS $2^{10}-1$ ZERO SUB 64	BIT	10^{-4}	CLOCK ECL	ECL	+30 ppm	CLOCK ECL	ECL	CLOCK 10^{8}	BIT
10	34368 kb *5	RZ	PRBS $2^{15}-1$ ZERO SUB 32	BIT	10^{-6}	CLOCK ECL	ECL	-30 ppm	CLOCK ECL	ECL	CLOCK 10^{9}	BLOCK
11	68736 kb *5	NRZ	PRBS $2^{23}-1$ ZERO SUB 0	BIT	OFF	$\overline{\text{CLOCK}}$ ECL	ECL	+30 ppm	$\overline{\text{CLOCK}}$ ECL	ECL	TIME 1 minute	BIT
12	139264 kb *5	RZ	PRBS $2^{23}-1$ ZERO SUB 120	BIT	10^{-4}	CLOCK ECL	ECL	-30 ppm	CLOCK ECL	ECL	TIME 1 minute	BIT
13 *6	OPTION *5	NRZ	PRBS $2^{23}-1$ ZERO SUB 0	BIT	10^{-3}	CLOCK ECL	ECL	OFF	CLOCK ECL	ECL	TIME 1 minute	BIT

(Note) Other Settings in receiver are:

. Jitter range	1 UI-PP
. Jitter rate	FAST
. Jitter hit threshold	0.5 UI-PP
. Single/Repeat measurement	SINGLE
. Interval time (rear panel)	0.01 sec
. Jitter (rear panel)	Internal Measuring Signal, Internal Reference Signal

The transmitter jitter modulation input must not be connected.

ZERO SUB stands for zero substitution.

*1 (Output) Clock: POLARITY/LEVEL

*2 (Output) Data: LEVEL

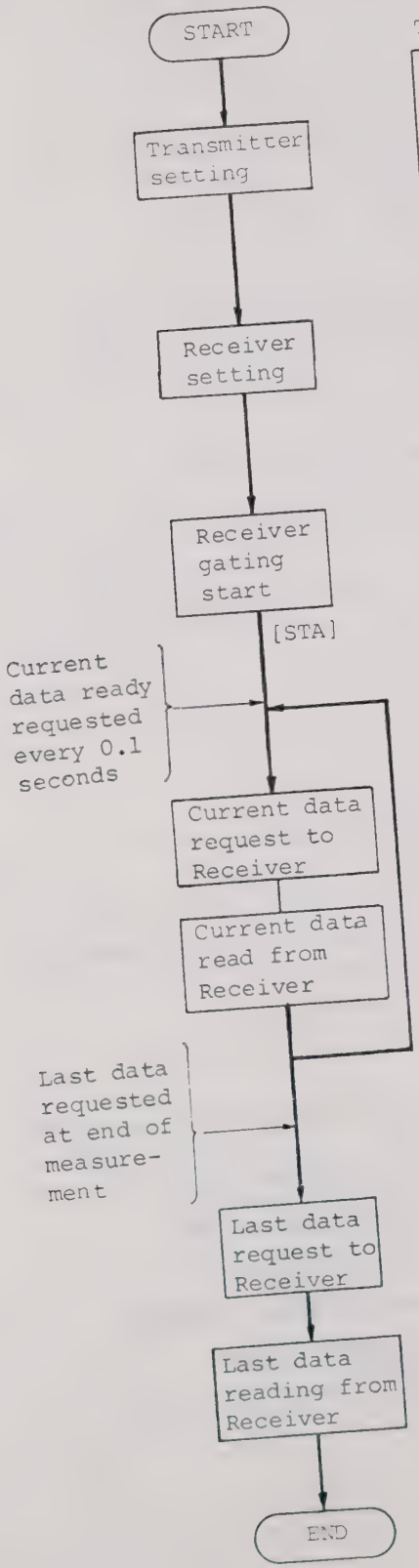
*3 (Input) Clock: POLARITY/THRESHOLD TERM

*4 (Input) Data: MODE/or THRESHOLD TERM

*5: Set the receiver to EXT.

*6: Executed only when the frequency option is installed in the Transmitter.

5.4 GP-IB Measurement Flowchart



Transmitter Settings

139M[BR1],CMI[FMC]
PN 2^{23}-1(zero substitution=0) [PTR3Z0]
Error addition=10^{-6} [EB6]
Clock offset and jitter modulation off[OFF]

Receiver settings

139M[BR1],CMI[FMC]
PN 2^{23}-1(zero substitution=0) [PRT3Z0]
CMI input termination [ILT]
Gating clock 10 [MGC10]
Current data mode [CUR]
Bit error mode [EMB]
Error count display [DEC]
Jitter UI-PP display [DJU]
Printer on [PON]

Current data request to Receiver

Output buffer clear [GCR]
Measuring time [GTM]
Error rate [GER], error count [GEC]
Error interval [GEI], Error-free interval [GEF]
Jitter UI-PP [GJU], Jitter UI+P (GJP]
Jitter UI-P [GJN], Jitter hits count [GJC]
Jitter hit interval [GJI],
Jitter hit free interval [GJF]

Last data request to Receiver

Output buffer clear [GCR], measuring time [GTM],
Last data mode [LAS]
Error rate [GER], error free interval [GEF]
Jitter UI-PP [GJU], Jitter UI+P [GJP]
Jitter UI-P [GJN], Jitter hit count [GJC]
Jitter hit interval [GJI],
Jitter hit-free interval [GJF]

Set the receiver address to 2 and the transmitter address to 1.

Transmitter setting

```
10 WRITE @101:"BR1,FMC,PTR3ZO,EB6,OFF"
```

Receiver setting

```
20 WRITE @102:"BR1,FMC,PTR3ZO,ILT,MGC10,CUR,EMB,DEC,DJU,FON"
```

Receiver measurement start

```
30 WRITE @102:"STA"
```

Service request judgement

```
40 STATUS @102:A
50 IF BIT(6,A)=0 THEN 40
60 IF BIT(5,A)=0 AND BIT(0,A)=1 THEN 200
70 IF BIT(5,A)=0 AND BIT(1,A)=1 THEN 300
80 GO TO 40
```

Current data request and reading

```
200 WRITE @102:"GCR,GTM,GER,GEC,GEI,GEF,GJU,GJF,GJN,GJC,GJI,GJF"
210 READ @102:D$
220 IF LEN(D$)=0 THEN 40
230 PRINT D$
240 GO TO 210
```

Program line 200 requests data from the receiver. Line 210 reads one line of data at string variable D$. Since there are no read data remaining when the length of the string variable at line 220 is 0, the program returns to line 40 for the next data. Line 230 outputs the contents of D$. Line 240 returns to line 210 to read the next data.

The result is output on the CRT (or PRINTER).

```
START  84-05-28  08/50/20
ERROR RATE                    1.222-04
ERROR COUNT                     751200
ERROR INTVLS                    241011
ERROR F.INTVLS                   82.124
JITTER UI PP             *       10.02
JITTER UI +P                      5.00
JITTER UI -P                      5.02
JITTER HIT COUNT                512851
JITTER HIT INTVLS               220000
JITTER HIT F.INTVLS              93.564
```

Last Data request and reading

```
300 WRITE @102:"GCR,LAS,GTM,GER,GEC,GEI,GEF,GJU,GJF,GJN,GJC,GJI,GJF"
310 READ @102:D$
320 IF LEN(D$)=0 THEN 350
330 PRINT D$
340 GO TO 310
350 END
```

The result is the same as for current data. However, the time component of 1st line is as follows:

```
START  84-05-28  08/54/10   STOP  84-05-28  08/53/12
```

The following two lines are required when executing the above program.

```
5 DIM D$*255
7 PRINTER IS @117
```

Line 5 is a statement specifying the data length of charactor variable D$.

Line 7 specifies GP-IB device number 17 for the printer as an output device.

5.5 PACKET III Sample Program

```
10 !*************************************************************
20 !*                                                           *
30 !*        ME520B DEMONSTRATION PROGRAM                       *
40 !*          < 1 TIME MEASUREMENT >                           *
50 !*     ANRITSU CORP.                                         *
60 !*       Measuring instrument devision                       *
70 !*                                                           *
80 !*                                                           *
90 !*                                    02-dec-1983            *
100 !                                                          *
110 DIM D$*80,ALARM$*80
120 ! Terminator constant define
130 LET CR$=CHR$(14)*LET LF$=CHR$(10)
140 ! Set GP-IB address of transmitter & receiver
150 LET TR=1*LET REC=2
160 !
165 !
170 ! Transmitter setting
180 !WRITE @100+TR:"BR139,FMNRZ,PTR3Z0,EB6,OCE,OLE,OL2,OFF"
190 ! Receiver setting
200 WRITE @100+REC:"BR1,FMC,PTR3Z0,ICP,ICE,ILE,ILTERM"
205 WRITE @100+REC:"MGC10,SINGLE,CURRENT,EMBIT,DEC,JR1,JRF,JFO,DJU,FOF,ESA"
210 !
220 ! Receiver gating start
230 WRITE @100+REC:"STA"
240 CLEAR
250 STREAD: ! Service request status read
260 STATUS @100+REC:A
270 ! SRQ exist check
280 IF BIT(6,A)=0 THEN GO TO STREAD
290 ! Alarm check
300 IF BIT(5,A)=1 THEN GO TO ALARM
310 ! Measure alarm check
315 IF BIT(4,A)=1 THEN GO TO MALARM
320 !
330 ! Current data ready check
340 IF BIT(0,A)=1 THEN GO TO CUREAD
350 ! Last data ready check
360 IF BIT(1,A)=1 THEN GO TO LSREAD
370 ! No data ready,then read status again
380 GO TO STREAD
390 !
400 !
410 !
420 ALARM: ! Alarm SRQ display on CRT
430 ! CRT cursor set to lower position
440 SET DISPLAY 11,"5,17"
450 RESTORE
460 ! Alarm comment search
470 FOR I=0 TO 4
480 READ ALARM$
490 IF BIT(I,A)=1 THEN PRINT ALARM$
500 NEXT I
510 GO TO STREAD
520 MALARM: ! Measure alarm SRQ display on CRT
530 RESTORE
531 ! CRT cursor set to lower position
532 SET DISPLAY 11,"5,17"
540 ! Alarm comment pointer set
550 FOR I=0 TO 4
560 READ ALARM$
570 NEXT I
580 ! Alarm comment search
590 FOR I=0 TO 3
600 READ ALARM$
610 IF BIT(I,A)=1 THEN PRINT ALARM$
620 NEXT I
```

```
630 ' Setting alarm comment                                          bit0
640 DATA "**  Input command illegal"'                                bit1
650 DATA "**  Measuring Alarm occurred"!                             bit2
660 DATA "**  Input bit rate boundary over(+-50ppm)"'                 bit3
670 DATA "**  Input bit rate boundary over(+-100ppm)"'                bit4
680 DATA "**  Unpermitted setting, gating unable to start"'
690 ' Measure alarm comment                                          bit0
700 DATA "**  Signal loss"!                                          bit1
710 DATA "**  Syncronization loss"!                                  bit2
720 DATA "**  AIS"'                                                  bit3
730 DATA "**  Abnormal power down "!
740 !
750 '
760 CUREAD: ' Current data request and read
770 WRITE @100+REC:"GCR,CUR,GTM,GERATE,GECOUNT,GEINTV,GEFREE,GJUIPP,GJPOS,GJNE
G,GJCOUNT,GJINTV,GJFREE"
780 ' CRT cursor set to home postition
790 SET DISPLAY 11,"0,0"
800 ' A delimiter set as line feed for 1 line read
810 TERM IS LF$
820 ' 1 line data read from receiver
830 READ @100+REC:D$
840 ' If no data then data end
850 IF LEN(D$)=0 THEN GO TO STREAD
860 !
870 !
880 PRINT D$
890 GO TO 810
900 '
910 !
920 LSREAD: ! Last data request and read
930 WRITE @100+REC:"GCR,GTM,LAST,GEALL,GJALL"
940 ! CRT cursor set to home position
950 SET DISPLAY 11,"0,0"
960 ! CRT all clear
970 CLEAR
980 !
990 !
1000 ! 1 line data read from receiver
1010 READ @100+REC:D$
1020 IF LEN(D$)=0 THEN GO TO END
1030 '
1040 '
1050 PRINT D$
1060 GO TO 990
1070 END: '
1080 LCL @100+TX
1090 LCL @100+REC
1100 END
```

Table 5-6 Output Data

If the first character in a data request code is "G", the code is a request for measurement data. If the first character is "L", it is a request for setting data. An asterisk * before a numeric value indicates that the data is invalid.

(RECEIVER)

Data request code[ ]	Output data	Explanation
[GTM]		
CURRENT 85-05-25 12/58/33		Date and time of measured data
[GER]		
ERROR RATE	1.01E-04	Error rate data
[GEC]		
ERROR COUNT	71	Error count data
[GEI]		
ERROR INTVLS	1	Error interval data
[GEF]		
ERROR F.INTVLS	0	Error-free interval data
[GE%]		
ERROR F.INTVL%	0.000	Error-free interval % data
[GEA]		
ERROR RATE	1.01E-04	Error related data batch
ERROR COUNT	71	
ERROR INTVLS	1	
ERROR F.INTVLS	0	
ERROR F.INTVL%	0.000	
[GED]		
ERROR RATE	1.01E-04	Error related display data
[GJU]		
JITTER UI PP	0.003	Jitter UI p-p data
[GJP]		
JITTER UI +P	0.000	Jitter UI +p data
[GJN]		
JITTER UI -P	0.004	Jitter UI -p data

(RECEIVER) (cont.)

Data request code [ ]	Output data		Explanation
[GJC] JITTER HIT COUNT	0		Jitter hit count data
[GJI] JITTER HIT INTVLS	0		Jitter hit interval data
[GJF] JITTER HIT F.INTVLS	1		Jitter hit-free interval data
[GJ%] JITTER HIT F.INTVL%	100.000		Jitter hit-free interval % data
[GJA]	0.003		Jitter related data batch
JITTER UI PP	0.000		
JITTER UI +P	0.004		
JITTER UI -P	0		
JITTER HIT COUNT	0		
JITTER HIT INTVLS	1		
JITTER HIT F.INTVLS	100.000		
JITTER HIT F.INTVL%			
[GJD] JITTER UI PP	0.003		Jitter related display data
[G%R1E] ER	9.94E-05	05-25 13/50/20	Performance: error rate data (15 minutes)
[G%U2E] % US	0.0000	05-25 13/50/20	Performance: Unavailable seconds (1 hour)
[G%S3E] % SES	0.0000	05-25 13/50/20	Performance: Severely errored seconds (1 day)
[G%D4E] % DM	* 0.0000	05-25 13/50/20	Performance: Degraded minutes (7 days)
[G%E5E] % ES	100.0000	05-25 13/50/20	Performance: Errored seconds (30 days)
[G%F1E] % EFS	0.0000	05-25 13/50/20	Performance: Error-free seconds (15 minutes)

(RECEIVER) (cont.)

Data request code [ ]	Output data		Explanation
[G%A1E]			
ER	9.94E-05	05-25 13/50/20	Error performance data
% US	0.0000	05-25 13/50/20	batch for 15 minutes.
% SES	0.0000	05-25 13/50/20	
% DM	* 0.0000	05-25 13/50/20	
% ES	100.0000	05-25 13/50/20	
% EFS	0.0000	05-25 13/50/20	
[LBR]			
BR7 BIT RATE= 704K			Bit rate set state (704 kb/s)
[LFM]			
FMA FORMAT=AMI			Format set state (AMI)
[LPT]			
PTR1Z0 PATTERN=PRBS 2^10-1			Pattern set state (PRBS 20^{10}-1)
[LIN]			
ILT INPUT=CMI/AMI/HDB3 TERM			Input condition set state (CMI/AMI/HDB3 termination)
[LMG]			
MGT1S GATING PERIOD=TIME 1S			Gating period set state (Time, 1 second gating)
[LRT]			
TIME=85-05-25 12/58/38			Current date and time (May 25, 1985 12:58:38)
[LME]			
STP_SIN_CUR MEASURE/EVALUATION=STOP SINGLE CURRENT			Measurement state (Stopped, one measurement and current data display)
[LEM]			
EMB ERROR MODE=BIT			Measurement error mode (Bit error)
[LED]			
DER DISPLAY MODE=ERROR RATE			Error display mode (Error rate display)
[LSY]			
ESA ERROR SYNC=AUTO SL NS AIS			Error sync set status and live status signal (Auto sync and following status signals on - Sync Loss, No Signal, AIS)
[LTH]			
EUC000704_ESC000704_EDC000043 THRESHOLD = %US 000704 %SES 000704 %DM 000043			Error performance threshold setting value (Error count setting, unavailable seconds 704, severely errored seconds 704, and degraded minutes 43)

(RECEIVER) (cont.)

Data request code [ ]	Output data	Explanation
[LJR]	JR1_JRF JITTER RANGE=1 RATE=FAST	Jitter measurement set state (Jitter range is 1 UI-PP and rate is FAST)
[LJF]	JFO JITTER FILTER=OFF	Jitter filter set state (OFF)
[LJH]	JT0.500 JITTER HIT THRESHOLD=0.500	Jitter hit threshold set state (0.500)
[LJD]	DJU DISPLAY MODE= JITTER UI P-P	Jitter display set state (Jitter UI-PP)
[LPR]	POF_PDN PRINTER=OFF NORMAL	Printer set state (Printer is Off in normal printing direction.)
[LPI]	PER_PJO PRINTING ERROR=RT JITTER=OFF	Print data set state (Related errors: error rate, and related jitters: none)
[LAF]	BOF_HI1_JCI_JMI BUZZER=OFF INTERVAL=1S JIT REF CLOCK=INT JIT MEASURE=INT CLN_DTP CMI LEVEL=CMI DATA=POS	Other set states (Buzzer: off, interval: 1 second, jitter REF clock: internal, jitter measurement: internal, CMI level: CMI and data signal polarity: positive)
[LAL]	BR7 BIT RATE= 704K FMA FORMAT=AMI PTR1Z0 PATTERN=PRBS 2^10-1 ILT INPUT=CMI/AMI/HDB3 TERM MGT1S GATING PERIOD=TIME 1S TIME=85-05-25 12/59/20 STP_SIN_CUR MEASURE/EVALUATION=STOP SINGLE CURRENT EMB ERROR MODE=BIT DER DISPLAY MODE=ERROR RATE ESA ERROR SYNC=AUTO JR1_JRF JITTER RANGE=1 RATE=FAST JFO JITTER FILTER=OFF JT0.500 JITTER HIT THRESHOLD=0.500 DJU DISPLAY MODE= JITTER UI P-P POF_PDN PRINTER=OFF NORMAL PER_PJO PRINTING ERROR=RT JITTER=OFF BOF_HI1_JCI_JMI BUZZER=OFF INTERVAL=1S JIT REF CLOCK=INT JIT MEASURE=INT CLN_DTP CMI LEVEL=CMI DATA=POS ATO CURRENT PRINT TRIGGER = OFF EUC000704_ESC000704_EDC000043 THRESHOLD = %US 000704 %SES 000704 %DM 000043	Set state batch

(TRANSMITTER)

Data request code [ ]	Output data	Explanation
[GJT]		
JITTER MODULATION=	0.02 P-P	Jitter modulation data
[LBR]		
BR7 BIT RATE=	704K	Bit rate set state (704 kb/s)
[LFM]		
FMA FORMAT=AMI		Format set state (AMI)
[LPT]		
PTR1ZO PATTERN=PRBS 2^10-1		Pattern set state (PRBS $2^{10}-1$)
[LEA]		
EB4 ERROR ADDITION=BIT 10^-4		Error addition (Bit error, 10^{-4})
[LOT]		
OCP_OCE_OL2 OUTPUT CLOCK=POS ECL AMI 2.37V		Output condition set state (Clock polarity: positive, clock level: ECL, and AMI level: 2.37 V)
[LOJ]		
FRE FREQ OFFSET/JIT/OFF=FREQUENCY OFFSET +10 PPM		Frequency offset and jitter modulation set state (Frequency offset +10 PPM)
[LAL]		
BR7 BIT RATE=	704K	Set state batch
FMA FORMAT=AMI		
PTR1ZO PATTERN=PRBS 2^10-1		
EB4 ERROR ADDITION=BIT 10^-4		
OCP_OCE_OL2 OUTPUT CLOCK=POS ECL AMI 2.37V		
FRE FREQ OFFSET/JIT/OFF=FREQUENCY OFFSET +10 PPM		

Table 5-7 I/O Signal Conditions Setting Commands

Code in [ ] can be omitted

Item	Contents	Code	Remarks
Bit rate	704K	BR7 [04]	For both transmitter and receiver
	2048K	BR2 [048]	
	8448K	BR8 [448]	
	34368K	BR3 [4368]	
	68736K	BR6 [8736]	
	139264K	BR1 [39264]	
	EXT	BRE [XT]	
	OPTION	BRO [PT]	(Option is only for Transmitter)
Format	AMI	FMA [MI]	For both transmitter and receiver
	HDB3	FMH [DB3]	
	CMI	FMC [MI]	
	NRZ	FMN [RZ]	
	RZ	FMR [Z]	
Pattern	PRBS $2^{10}-1$	RTR1 [Z120] *1	For both transmitter and receiver
	PRBS $2^{15}-1$	PTR2 [Z120] *1	*1: Decimal ASCII, 3 digits
	PRBS $2^{23}-1$	PTR3 [Z120] *1	*2: Data format code H: Hexadecimal ASCII B: Binary ASCII
	Zero substitution	PTRZ 120 *1	*3: Hexadecimal or binary ASCII Digits 0-4 (binary 16) are for work data use.
	Word 1-16	PTW1 [H FFFF] *2 *3	1: High level 0: Low level

Table 5-7 (Cont.)

Code in [ ] can be omitted

Item	Contents	Code	Remarks
Pattern (Cont.)	2x8	PTWO [H FFFF] *2 *3	2x8 word is only for Transmitter.
	Word data	PTWD H FFFF *2 *3	
Output	Clock polarity		For transmitter
	CLOCK	OCP [OS]	
	$\overline{\text{CLOCK}}$	OCN [EG]	
	Clock level		
	TTL	OCT [TL]	
	ECL	OCE [CL]	
	SET	OCS [ET]	
	NRZ, RZ		
	TTL	OLT [TL]	
	ECL	OLE [CL]	
	SET	OLS [ET]	
	AMI, HDB3		
	2.37 V	OL2 [.37V]	
	1 V	OL1 [V]	
Input	Clock polarity		For receiver
	CLOCK	ICP [OS]	
	$\overline{\text{CLOCK}}$	ICN [EG]	
	Clock threshold		
	AUTO	ICA [UTO]	
	GND	ICG [ND]	
	ECL	ICE [CL]	
	NRZ, RZ threshold		
	MAN	ILS [ET]	
	GND	ILG [ND]	
	ECL	ILE [CL]	
	CMI, AMI, HDB3 mode		
	TERM	ILT [ERM]	
	MON	ILM [ON]	

Table 5-7 (Cont.)

Code in [ ] can be omitted

Item	Contents	Code	Remarks
Error addition	BIT 10^{-6}	EB6	For transmitter
	10^{-5}	EB5	
	10^{-4}	EB4	
	10^{-3}	EB3	
	SINGLE	EBS [INGLE]	Outputs single error.
	EXT	EBE [XT]	
	OFF	EBO [FF]	
	CODE		
	10^{-6}	EC6	
	10^{-5}	EC5	
	10^{-4}	EC4	
	10^{-3}	EC3	
	SINGLE	ECS [INGLE]	Outputs single error.
	EXT	ECE [XT]	
	OFF	ECO [FF]	
Offset, jitter mode	Frequency offset (-100...+100PPM)	FRQ +100/*	For transmitter *: Decimal ASCII
		FRQ -100/*	With 1 to 4 digit code
	Jitter modulation with frequency offset	JIT +100/*	
	OFF	OFF	

Table 5-8 Measurement Conditions Setting Commands

Code in [ ] can be omitted

Item	Contents	Code	Remarks
Set gating condition	Manual	MGMA [N]	For receiver
	Clock 10^6	MGC6	
	10^7	MGC7	
	10^8	MGC8	
	10^9	MGC9	
	10^{10}	MGC10	
	10^{11}	MGC11	
	10^{12}	MGC12	
	Time	MGT 1S * (Measuring time: 1 second)	*: Decimal ASCII 1 to 2 digits One second to 99 days can be set.
		MGT 5H [15M 30S] * * * (Measuring time: 5 hours 15 minutes 30 second)	
		MGT 10 D[5H 15M] * * * (Measuring time: 10 days 5 hours 15 minutes)	
Clock	Year, month, date, hour, minute	RT84Y11 24D14H20M (1984 November 24, 14 hours 20 minutes)	For receiver 00 is set in seconds.

Table 5-8 (Cont.)

Code in [ ] can be omitted

Item	Contents	Code	Remarks
Measurement condition	Start (except error performance mode)	STA [RT]	For receiver
	Start (error performance mode)	STS	
	Stop	STP	
	Single	SIN [GLE]	
	Repeat	REP	
	Last data mode	LAS [T]	
	Current data mode	CUR [RENT]	
Error	Measurement mode		For receiver
	Bit	EMB	
	Code	EMC	
	Block	EML	
	Display mode		
	Rate	DER [ATE]	
	Count	DEC [OUNT]	
	Interval	DEI [NTV]	
	Free intervals	DEF [REE]	
	Free intervals%	DE%	
	%US	D%U	
	%SES	D%S	
	%DM	D%D	

Table 5-8 (Cont.)

Code in [ ] can be omitted

Item	Contents	Code	Remarks
Error (cont.)	%ES	D%E	
	%EFS	D%F	
	SYNC		
	Automatic	ESA [UTO]	
	Manual	ESM [AN]	
Jitter	Range 1	JR1	For receiver
	10	JR2	
	Rate Slow	JRS [LOW]	
	Medium	JRM [ID]	
	Fast	JRF [AST]	
	Filter		
	HP1, LP	JF1	
	HP2, LP	JF2	
	LP	JFL	
	OFF	JFO [FF]	
	Hit threshold	JT 5.00 *	*: Range 10: Decimal-one digit ignored.
		JT 0.500 *	Setting range: Range 1: 0.050-0.500 Range 10: 0.500-5.00

Table 5-8 (Cont.)

Code in [ ] can be omitted

Item	Contents	Code	Remarks
Jitter (cont.)	Display mode		Numeric is decimal ASCII 1 to 4 digits.
	Jitter UI p-p	DJU [IPP]	
	UI +p	DJP [OS]	
	UI -p	DJN [EG]	
	Hit count	DJC [OUNT]	
	Hit free intervals	DJI [NTV]	
	Hit free intervals	DJF [REE]	
	Hit free intervals%	DJ%	
Jitter print	Jitter UI print	PJT [RIG]	For receiver Valid once only.

Table 5-9 Rear Panel Switch and Internal Switch Setting Condition Commands

Code in [ ] can be omitted

Item	Contents	Code	Remarks
Panel Lock	Panel lock	PNL	For both transmitter and receiver
	Panel unlock	PNU	
Additional function	Data: DATA	DTP [OS]	For both transmitter and receiver
	DATA	DTN [EG]	
	Buzzer ON	BON	For receiver
	OFF	BOF	
	Interval time		
	1 s	HI1	
	0.1 s	HI2	
	0.01 s	HI3	
	Jitter reference clock		
	Internal	JCI [NT]	
	External	JCE [XT]	
	Jitter measurement signal		
	Internal	JMI [NT]	
	External	JME [XT]	
	Counter function		
	OFF	ACF	
	Count	ACT	
	CMI input/output level		
	CMI level	CLN [ORMAL]	For both transmitter and receiver
	ECL level	CLE [CL]	
	Measurement start condition		For receiver
	Wait for jitter alarm reset	ANS	
	Start even with jitter alarm	AST	

Table 5-9 (Cont.)

Code in [ ] can be omitted

Item	Contents	Code	Remarks
Error performance threshold	Unavailable Seconds E.R.	EUR 1E-3/*1	For receiver Each threshold of the unavailable seconds, severely errored seconds and degraded minutes can be set for every bit rate.
	E.C.	EUC 999999/*2	
	Severely errored Seconds E.R.	ESR 1E-3/*3	The ranges of the numeric values are as follows: *1: 1E-2 to 1E-4 *2: 1 to 1.99E7 *3: 1E-2 to 1E-4 *4: 1 to 1.99E7 *5: 1E-5 to 1E-7 *6: 1 to 1.99E8
	E.C.	ESC 999999/*4	
	Degraded minutes E.R.	EDR 1E-6/*5	
	E.C.	EDC 999999/*6	Integers to 999999 can be input into *2, *4 and *6. Input an exponent into 1E6 to 9E7 (9E8). After the end of a self-test, all performance thresholds are initialized. For *1 to *4, the values are equivalent to 10^{-3} of each bit rate and for *5 and *6, the values are equivalent to 10^{-6} of each bit rate.

Note: When the measured values and thresholds are compared, the count values are compared and not the rates. A count value of less than one obtained in a calculation is counted as one.

Table 5-10 Data Output Request Commands to GP-IB Bus

Code in [ ] can be omitted

Item	Contents	Code	Remarks
GP-IB error data request	Measuring time	GTM	For receiver
	Error rate output	GER [ATE]	
	Error count output	GEC [OUNT]	
	Error interval output	GEI [NTV]	
	Error free intervals output	GEF [REE]	
	Error free intervals% output	GE%	
	All error items output	GEA [LL]	
	Displayed error output	GED [ISP]	
GP-IB jitter data request	Jitter pp output	GJU [IPP]	For receiver
	Jitter +P output	GJP [OS]	
	Jitter -P output	GJN [EG]	
	Jitter hit count output	GJC [OUNT]	
	Jitter hit intervals output	GJI [NTV]	
	Jitter hit free intervals output	GJF [REE]	
	Jitter hit free intervals% output	GJ%	

Table 5-10 (Cont.)

Code in [ ] can be omitted

Item	Contents	Code	Remarks
GP-IB jitter data request (cont'd)	All jitter items output	GJA [LL]	For receiver
	Displayed jitter output	GJD [ISP]	
GP-IB jitter data request	Jitter modulation data output	GJT	For transmitter
GP-IB data request	Output buffer clear	GCR	For both transmitter and receiver
GP-IB error Performance			For receiver
Data request	Error rate	G%R $\frac{1}{*1}$ E	*1: An integer from 1 to 5, which means as follows: 1 - Error performance data for 15 minutes 2 - Error performance data for 1 hour 3 - Error performance data for 1 day 4 - Error performance data for 7 days 5 - Error performance data for 30 days
	Unavailable Second	G%U $\frac{1}{*1}$ E	
	Severely errored Second	G%S $\frac{1}{*1}$ E	
	Degrated minutes	G%D $\frac{1}{*1}$ E	
	Errored Second	G%E $\frac{1}{*1}$ E	
	Error free second	G%F $\frac{1}{*1}$ E	

Table 5-11 Setting Status Output Request Commands to GP-IB Bus

Code in [ ] can be omitted

Item	Contents	Code	Remarks
Set conditions output (setting on panel)	All setting items	LAL	For both transmitter and receiver
	Bit rate	LBR	For both transmitter and receiver
	Format	LFM	
	Pattern	LPT	
	Error addition	LEA	For transmitter
	Output conditions	LOT	
	Offset or jitter	LOJ	
	Input setting	LIN	For receiver
	Gating time	LMG	
	Gating clock	LRT	
	Measurement conditions: Start/Stop, Single/Repeat, Last/Current	LME	

Table 5-11 (Cont.)

Code in [ ] can be omitted

Item	Contents	Code	Remarks
Set conditions output (setting on panel)	Error mode	LEM	For receiver
	Error display	LED	
	SYNC automatic/ manual	LSY	
	Error performance threshold	LTH	
	Jitter (range/rate)	LJR	
	Jitter filter	LJF	
	Jitter hit threshold value	LJH	
	Jitter display	LJD	
	Printer (ON/OFF, forward/reverse)	LPR	
	Printing (error, jitter)	LPI	
	Additional functions (internal and rear panel)	LAF	

Table 5-12 Built-in Printer Control Commands

Code in [ ] can be omitted

Item	Contents	Code	Remarks
Printer	ON	PON	For built-in receiver printer
	OFF	POF	
	Printing direction:		
	Forward	PDN [ORMAL]	
	Reverse	PDR [EVERSE]	
Error data printing	Error data printing OFF	PEO	For built-in receiver printer
	All error items printing	PEA	
	Displayed error printing	PED	
Jitter data printing	Jitter printing OFF	PJO	For built-in receiver printer
	All jitter items printing	PJA	
	Displayed jitter printing	PJD	
Print trigger (at current mode)	%SES trigger	ATS	For built-in receiver printer
	%DM trigger	ATD	
	%ES trigger	ATE	
	trigger off	ATO	
Character printing	Characters (for optional printer)	PL, $\frac{xxx\sim x}{*3}$ (EOI)	For built-in receiver printer *3: From 0 to 20 numerics and arbitrary chatacters can be used. Always make the end signal (EOI).

Table 5-13 External Clock Jitter Modulation Control Commands

Code in [ ] can be omitted

Item	Contents	Code	Remarks
External clock jitter modulation	External clock bit rate setting		For transmitter
	704K	BE7 [04]	
	2048K	BE2 [048]	
	8448K	BE8 [448]	
	34368K	BE3 [4368]	
	68736K	BE6 [8736]	
	139264K	BE1 [39264]	
	OPTION	BE0 [PT]	

SECTION 6

PERFORMANCE CHECK

6.1 Introduction

This Section describes the methods for testing performance.

Checks may be performed for acceptance testing, inspections after repair, or periodic calibration.

If the instrument passes all the tests described, it is operating normally. Make the necessary adjustments in accordance with the service manual if items detected in these tests do not satisfy the specifications. If the specifications are still not met after adjustments, request service by ANRITSU or an ANRITSU dealer.

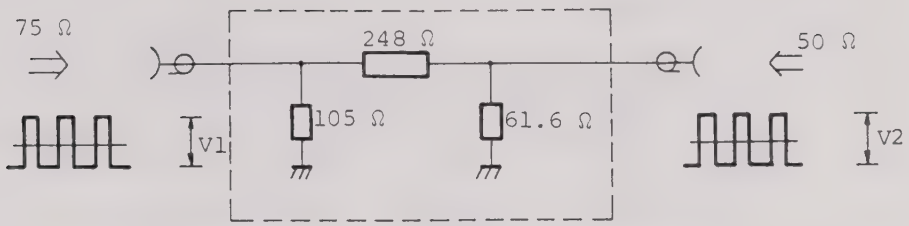
Table 6-1 lists the equipment required for performance checks.

6.2 Equipment Required for Performance Checks

Table 6-1 Equipment Required for Performance Checks

Equipment	Required Performance	Paragraph No. to be Checked
Pattern Generator (ME520B T)	(See specification)	6.5.1 to 6.5.24
Frequency Counter	Frequency Range, accuracy 5×10^{-8} 10 Hz to 500 MHz,	6.4.1, 6.4.2
Function Generator	Frequency Range: 1 kHz to 10 MHz Waveform: Square Wave, Triangle	6.4.2, 6.4.7
Signal Generator (MG523A)	Frequency Range: 10 MHz to 200 MHz Output Level: (max) + 10 dBm	6.4.2, 6.4.3, 6.4.8, 6.4.9, 6.4.12, 6.4.13 6.5.7
Oscilloscope	Frequency Range: Dc to 500 MHz	6.4.2 to 6.4.17 (except 6.4.8) 6.5.15 to 6.5.23 (except 6.5.21)
50/75 Ω Impedance Transformer (MP540A)	Frequency Range: 10 MHz to 200 MHz Impedance: 50 Ω to 75 Ω	6.4.2 to 6.4.4, 6.4.8, 6.4.9, 6.4.12
75/50 Ω Matching Pad MP548A	Frequency Range: Dc to 200 MHz (See Fig. 6-1.)	6.4.1 to 6.4.17, (except 6.4.4), 6.5.16
ECL Level Converter MP549A	Frequency Range: Dc to 200 MHz (See Fig. 6-2.)	6.4.3 to 6.4.6, 6.4.9 to 6.4.13, 6.5.16, 6.5.19 to 6.5.21
Universal Counter	Measuring Range: 10 Hz to 500 MHz	6.4.4, 6.4.8, 6.5.19, 6.5.21
Tee Adapter	Frequency Range: Dc to 500 MHz Connector: BNC (75 Ω)	6.4.7
Signal Generator (MG442A)	Frequency Range: Dc to 10 MHz Output Level: (max) +15 dBm	6.4.13, 6.5.15 to 6.5.18
Resistance Attenuator (MN510D)	Frequency Range: Dc to 500 MHz Connector: BNC (75 Ω)	6.5.2, 6.5.5
Coaxial Adapter SP-3CP•3C-J (J0052)	Frequency Range: Dc to 500 MHz	6.5.2, 6.5.5
Digital Voltmeter	Dc ±20 V	6.5.24

(1) 75 Ω - 50 Ω Matching Pad MP548A

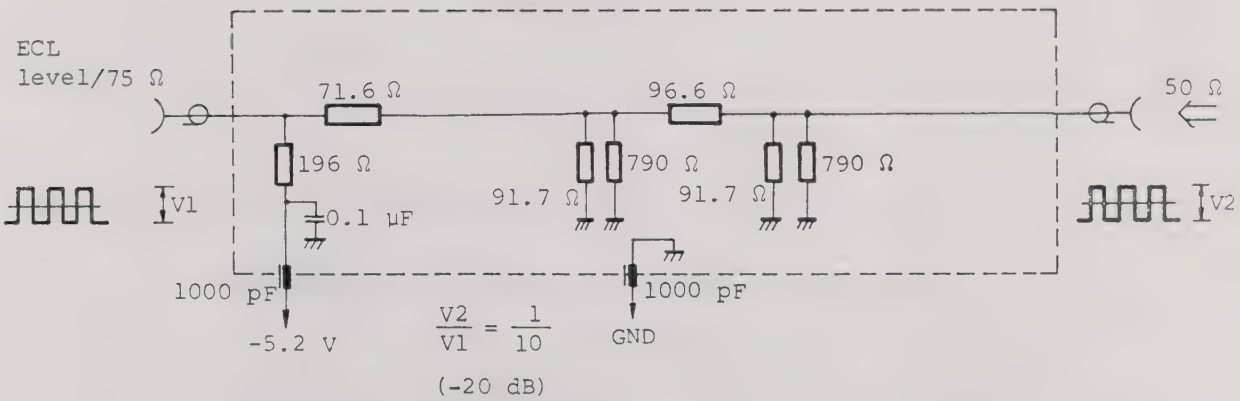


$$\frac{V2}{V1} = \frac{1}{10}$$

(-20 dB)

Fig. 6-1 75/50 Ω Matching Pad

(2) ECL Level Converter MP549A



$$\frac{V2}{V1} = \frac{1}{10}$$

(-20 dB)

Fig. 6-2 ECL Level Converter

6.3 Preliminary Operations

(1) Specifications are guaranteed for temperatures from 0° to 50°C.

(2) The test instrument must be warmed up for 30 minutes or more, unless otherwise specified in the test procedure.

6.4 Transmitter Performance Check

6.4.1 Internal clock frequency accuracy and offset check

(1) Specifications

Bit rate: 704 kb/s
2048 kb/s
8448 kb/s
34368 kb/s
68736 kb/s
139264 kb/s
EXT
Option (one of from 1 kb/s to 170 Mb/s)

Accuracy: ±2 ppm at ambient temperature
Typically $\leqq$ ±5 ppm/0° to 50°C
Typically $\leqq$ ±2 ppm/year aging

Offset: 0 to ±100 ppm in 1 ppm steps

(2) Configuration

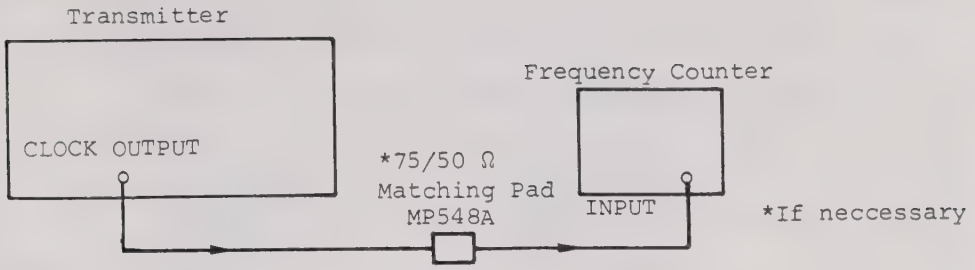
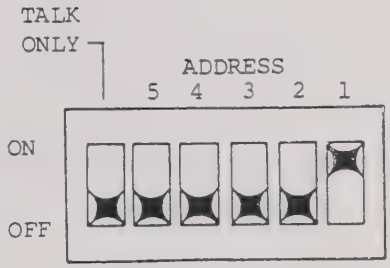


Fig. 6-3 Internal Clock Frequency Accuracy and Offset Check

(3) Procedures

Step	Procedure	
1	Connect the transmitter as shown in Fig. 6-3.	
2	Set the transmitter controls as follows:	
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)	
b)	Turn on the transmitter.	
c)	BIT RATE kb/s (T-1)	704 (kb/s)
d)	FORMAT (T-1)	NRZ
e)	PATTERN-PRBS (T-2)	$2^{10}-1$
f)	PATTERN-PRBS ZERO SUBSTITUTION (T-2)	OFF

(cont.)

Step	Procedure	
g)	ERROR ADDITION [MODE] (T-3)	BIT
h)	ERROR ADDITION [RATE] (T-3)	OFF
i)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
j)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
k)	OUTPUT-NRZ RZ [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
l)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

3 Set BIT RATE sequentially through 704 → 2048 → 8448 → 34368 → 68736 → 139264 → OPTION in order with [BIT RATE kb/s] key.
Using a frequency counter, check that the frequency is within the nominal bit rate value ±2 ppm. (See limits in Table 6-2.)

4 Set FREQ OFFSET/JITTER MOD to FREQ OFFSET with the [MODE] key.

5 Change the frequency offset value from -100 ppm to +100 ppm with the ppm [⩔] and [⩓] switches.

6 Measure the clock frequency with a frequency counter as explained in step 3. Check that its value can be changed within the nominal bit rate value ±100 ppm. (See Table 6-3.)

Table 6-2 Internal Clock Frequency Limits

Bit Rate Setting (kb/s)	Nominal Internal Clock Frequency (kHz) (fo)	Measured Frequency (kHz)	
		Minimum (fo -2 ppm)	Maximum (fo +2 ppm)
704	704.000	703.9986	704.0014
2048	2048.000	2047.9959	2048.0041
8448	8448.000	8447.9831	8448.0169
34368	34368.000	34367.9313	34368.0687
68736	68736.000	68735.8625	68736.1375
139264	139264.000	139263.7215	139264.2785
(Option)	fΔ	fΔ -2 ppm	fΔ +2 ppm

Table 6-3 Internal Clock Frequency Offset Limits (Typical)

Bit Rate Setting (kb/s)	Nominal Internal Clock Frequency (kHz) (fo)	Measured Frequency (kHz)	
		Minimum (fo -100 ppm)	Maximum (fo +100 ppm)
704	704.000	703.9296	704.0704
2048	2048.000	2047.7952	2048.2048
8448	8448.000	8447.1552	8448.8448
34368	34368.000	34364.5632	34371.4368
68736	68736.000	68729.1264	68742.8736
139264	139264.000	139250.0736	139277.9264
(Option)	fΔ	fΔ -100 ppm	fΔ +100 ppm

6.4.2 External clock frequency and amplitude check

(1) Specifications

Frequency: 1 kHz to 150 MHz
(Option 02: up to 170 MHz)

Impedance: Nominal 75 Ω unbalanced

Termination: Ground

Amplitude: 0.3 to 3 Vp-p (operable), limit ±3 V
1 kHz to 1 MHz .... Square Wave
1 MHz to 170 MHz .. Sine or Square Wave

Duty cycle: 50%

(2) Configuration

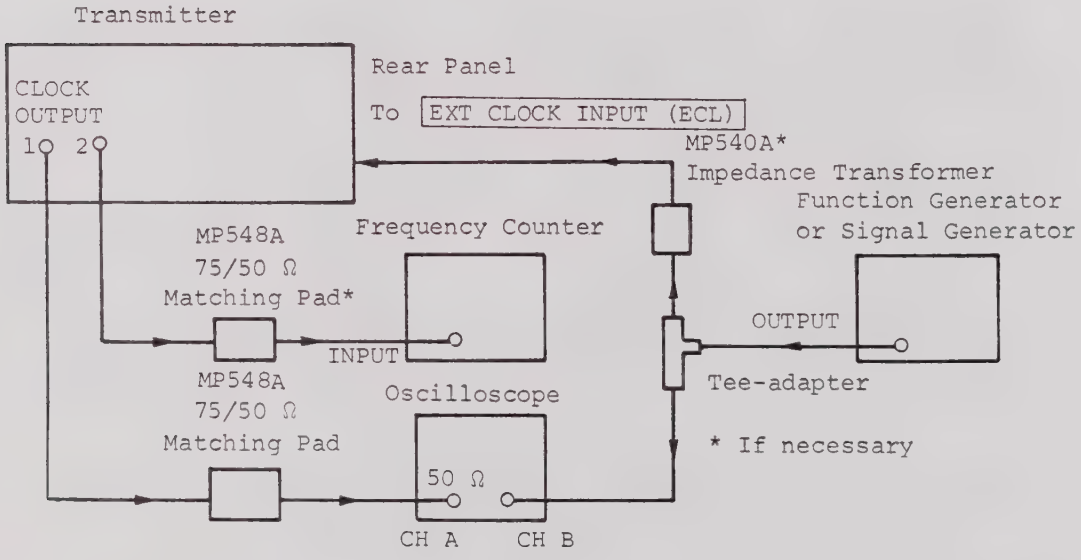
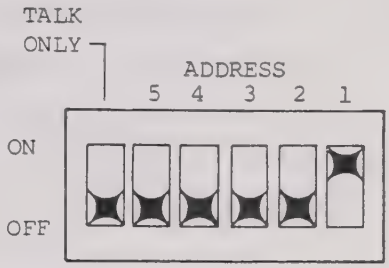


Fig. 6-4 External Clock Frequency and Amplitude Check

(3) Procedures

Step	Procedure	
1	Connect the transmitter as shown in Fig. 6-4.	
2	Set the transmitter controls as follows:	
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)	
b)	BIT RATE kb/s (T-1)	EXT
c)	FORMAT (T-1)	NRZ
d)	PATTERN-PRBS (T-2)	$2^{10}-1$
e)	PATTERN-PRBS ZERO SUBSTITUTION (T-2)	OFF
f)	ERROR ADDITION [MODE] (T-3)	BIT
g)	ERROR ADDITION [RATE] (T-3)	OFF
h)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
i)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	OUTPUT-NRZ RZ [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
k)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

(cont.)

Step	Procedure
3	Change the output signal frequency of the function generator or signal generator within the rating above (paragraph 6.4.2) and check that: a) The frequency counter measured value (clock frequency) matches the signal generator frequency. b) The clock waveform on the oscilloscope does not change. (See Fig. 6-5.)

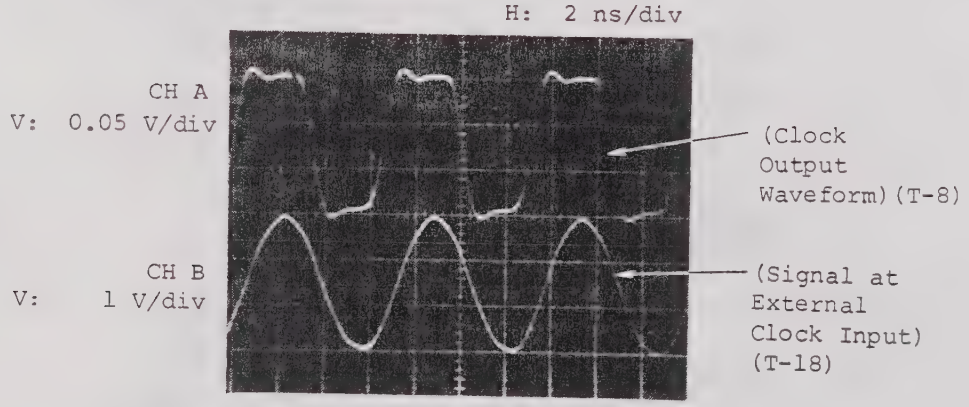


Fig. 6-5 CLOCK-OUTPUT Waveform and EXT CLOCK-INPUT Signal

6.4.3 Clock output check

(1) Specifications

Numbers: 2 separate buffered outputs, common phase

Polarity: Selectable CLOCK or $\overline{\text{CLOCK}}$

Level: Selectable TTL, ECL, or manual SET

TTL: TTL level (high state ≅ 2.5 V, low state ≅ 0.5 V)

ECL: ECL level

SET: Amplitude 1 to 2 V, offset 0 to ±2 V

Format: Square wave, 50 ±10% duty cycle on internal clock

Impedance: 75 Ω unbalanced

(2) Configuration

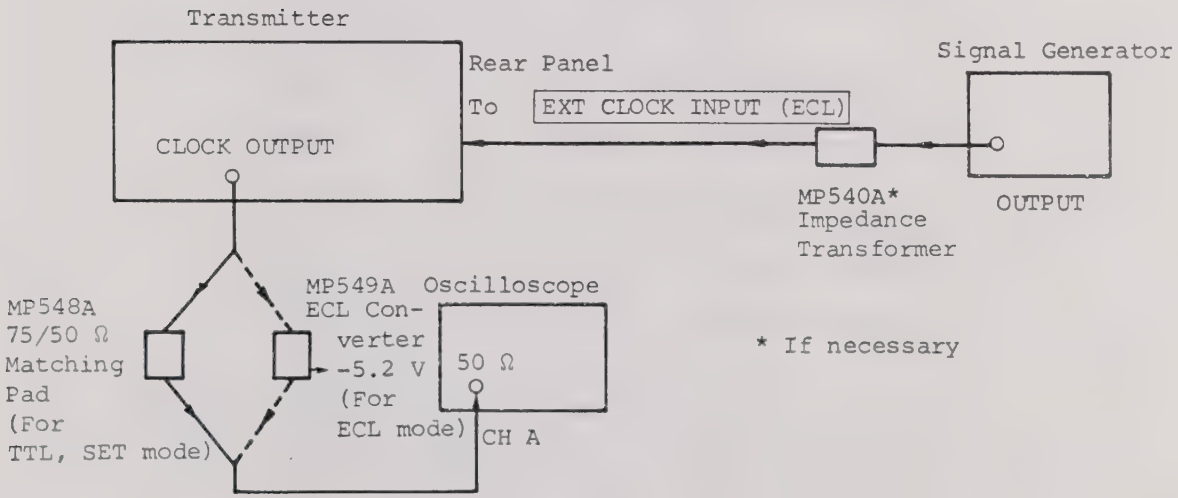
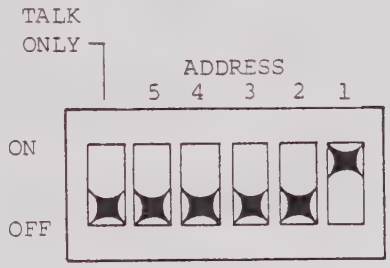


Fig. 6-6 Clock Output Check

(3) Procedures

Step	Procedure	
1	Connect the transmitter as shown in Fig. 6-6.	
2	Set the transmitter controls as follows:	
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)	
b)	BIT RATE kb/s (T-1)	EXT
c)	FORMAT (T-1)	NRZ
d)	PATTERN-PRBS (T-2)	$2^{10}-1$
e)	PATTERN-PRBS ZERO SUBSTITUTION (T-2)	OFF
f)	ERROR ADDITION [MODE] (T-3)	BIT
g)	ERROR ADDITION [RATE] (T-3)	OFF
h)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
i)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	OUTPUT-NRZ RZ [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
k)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

(cont.)

Step	Procedure
3	Apply the following signal to EXT CLOCK-INPUT connector. (Transmitter rear panel) Frequency: 150 MHz (170 MHz when Option 02 is installed) Level: 0 dBm (typical) Waveform: Sine wave
	Output Level TTL
4	Set OUTPUT to TTL with the CLOCK [LEVEL] key.
5	Confirm that the CLOCK-OUTPUT levels correspond to the waveform shown in Fig. 6-7 using the 75/50 Ω Matching Pad MP548A.
	Output Level ECL
6	Set OUTPUT to ECL with the CLOCK [LEVEL] key.
7	Check that the CLOCK-OUTPUT levels correspond to the waveform shown in Fig. 6-8 using the ECL level converter MP549A.
	Output Level SET
8	Set OUTPUT to SET with the CLOCK [LEVEL] key.
9	Check the following items using a 75/50 Ω matching pad MP548A: a) Turn the CLOCK-LEVEL AMPLITUDE variable resistor with a standard screwdriver. Check that the clock-output connector signal amplitude value (Fig. 6-9 - Va) varies over the 1 V to 2 V range.

(cont.)

Step	Procedure
b)	Turn the CLOCK-LEVEL OFFSET variable resistor with a standard screwdriver. Check that the clock-output connector signal dc offset value (Fig. 6-9 - Vo) varies over the -2 V to +2 V range.

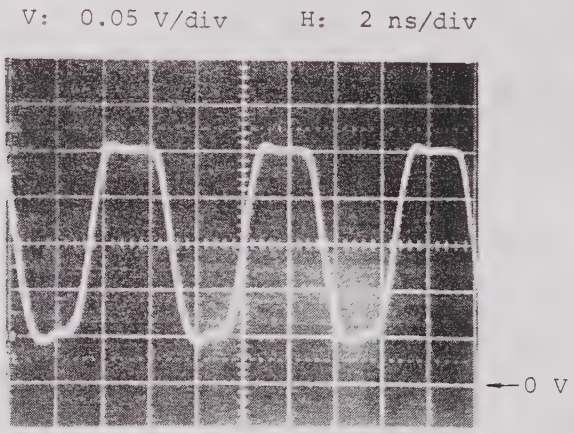


Fig. 6-7 CLOCK-OUTPUT (TTL) Waveform

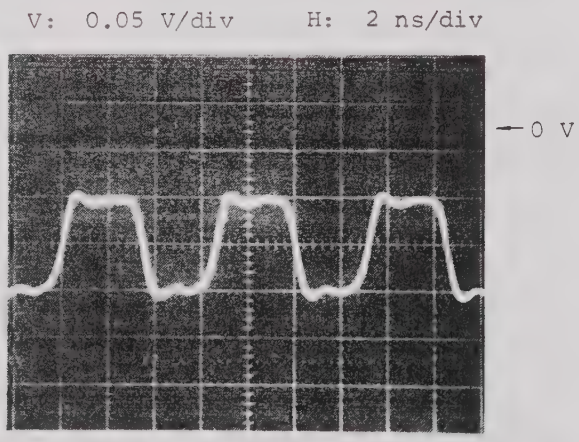


Fig. 6-8 CLOCK-OUTPUT (ECL) Waveform

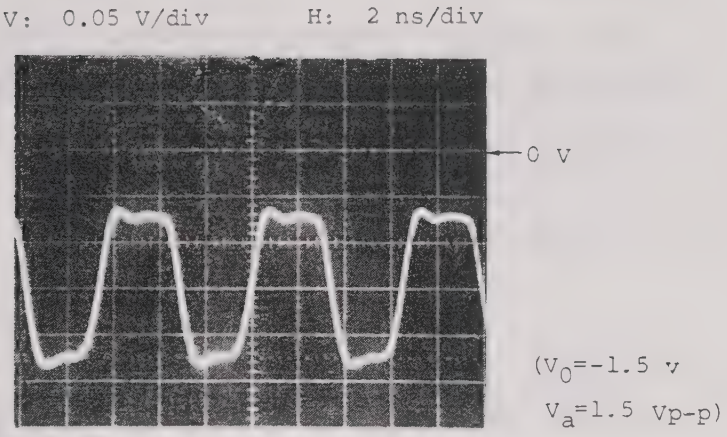


Fig. 6-9 CLOCK-OUTPUT Amplitude/Dc Offset Value Check

6.4.4 PRBS pattern check

(1) Specifications

2^{10}-1: Inverted signal
2^{15}-1: Inverted signal, CCITT Rec. O.151
2^{23}-1: Inverted signal, CCITT Rec. O.151

(2) Configuration

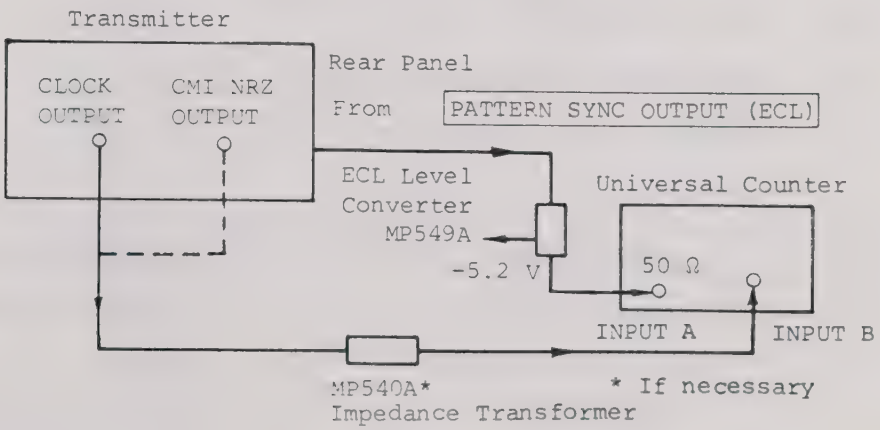
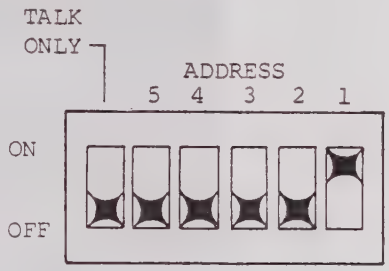


Fig. 6-10 PRBS Pattern Check

(3) Procedures

The PRBS is checked by calculating the number of clock pulses and data "1s" occuring during a PRBS sequence.

Step	Procedure	
1	Connect the transmitter as shown in Fig. 6-10.	
2	Set the transmitter controls as follows:	
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)	
b)	BIT RATE kb/s (T-1)	8448 (kb/s)
c)	FORMAT (T-1)	NRZ
d)	PATTERN-PRBS (T-2)	$2^{10}-1$
e)	PATTERN-PRBS ZERO SUBSTITUTION (T-2)	OFF
f)	ERROR ADDITION [MODE] (T-3)	BIT
g)	ERROR ADDITION [RATE] (T-3)	OFF
h)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
i)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	OUTPUT-NRZ RZ [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
k)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

(cont.)

Step	Procedure
3	Set the universal counter function switch to RATIO B/A and the frequency resolution switch to 10 (0.1 MHz).
4	Press the PATTERN-PRBS [2^{15}-1] and [2^{23}-1] keys respectively.
5	Confirm that the universal counter display corresponds to PRBS pattern shown in Table 6-4.
6	Disconnect the coaxial cable from the CLOCK-OUTPUT connector and connect it to the CMI NRZ RZ-OUTPUT connector.
7	Press the PATTERN-PRBS [2^{10}-1], [2^{15}-1], and [2^{23}-1] keys.
8	Confirm that the universal counter display corresponds to the PRBS pattern shown under NRZ data in Table 6-5.
9	Set FORMAT to RZ with the [FORMAT] key.
10	Press the PATTERN-PRBS [2^{10}-1], [2^{15}-1] and [2^{23}-1] keys.
11	Confirm that the universal counter display corresponds to the PRBS pattern shown under RZ data in Table 6-5.

Table 6-4 PRBS Clock Pulse Number

Pattern (PRBS) Setting	Counter Display: Transmitter CLOCK OUTPUT
$2^{10}-1$	1023
$2^{15}-1$	32767
$2^{23}-1$	8388607

Table 6-5 PRBS Data 1s Number

Pattern (PRBS) Setting	Transmitter NRZ/RZ output	
	NRZ Data	RZ Data
$2^{10}-1$	256	511
$2^{15}-1$	8192	16383
$2^{23}-1$	2097152	4194303

6.4.5 PRBS zero substitution check

(1) Specifications

The sequence can be disabled for 8 to 120 clock periods in multiples of 8 clock periods. Zero substitution gating occurs in every sequence after the longest zero sequence in a PRBS pattern.

(2) Configuration

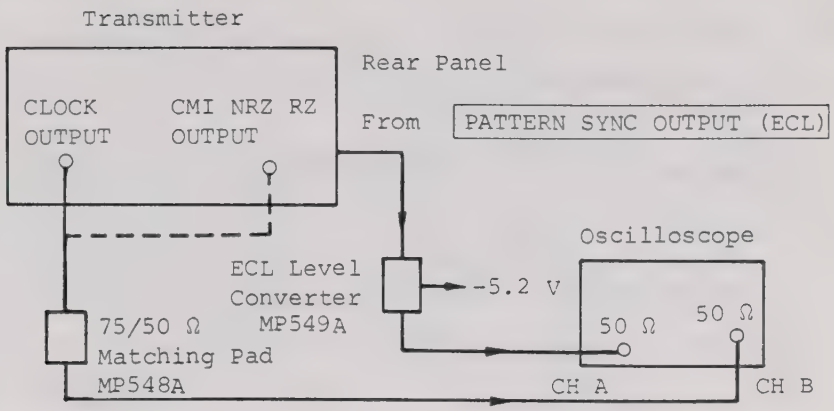
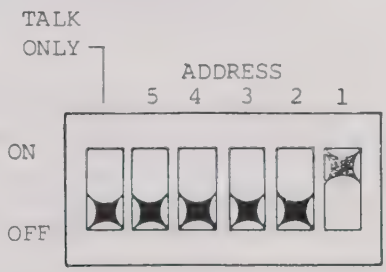


Fig. 6-11 PRBS Zero Substitution Check

(3) Procedures

Step	Procedure
1	Connect the transmitter as shown in Fig. 6-11.
2	Confirm that the transmitter controls are set as follows:
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)
b)	BIT RATE kb/s (T-1) 704 (kb/s)
c)	FORMAT (T-1) NRZ



(cont.)

Step	Procedure	
d)	PATTERN-PRBS (T-2)	$2^{10}-1$
e)	PATTERN-PRBS ZERO SUBSTITUTION (T-2)	OFF
f)	ERROR ADDITION [MODE] (T-3)	BIT
g)	ERROR ADDITION [RATE] (T-3)	OFF
h)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
i)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	OUTPUT-NRZ RZ [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
k)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

3 Set BIT RATE to 139264 (or other setting) with the [BIT RATE kb/s] key.

4 Trigger the oscilloscope with the +ve (positive) edge of the channel A signal. (See Fig. 6-12.)

5 Adjust the oscilloscope to display a trigger pulse over one horizontal division. (Fig. 6-12 gives a typical display.) Check that the pattern sync pulse width is two clock periods wide.

6 Disconnect the coaxial cable from the CLOCK-OUTPUT connector and connect it to CMI NRZ RZ-OUTPUT connector.

(cont.)

Step	Procedure
7	Confirm that the oscilloscope display corresponds to zero substitution waveform shown in Fig. 6-13 (a).
8	Set the PATTERN-PRBS ZERO SUBSTITUTION pattern to 8 (or 16 ... 120) with the [⩓] key, and check that the oscilloscope display corresponds to the zero substitution waveform shown in Fig. 6-13(b).

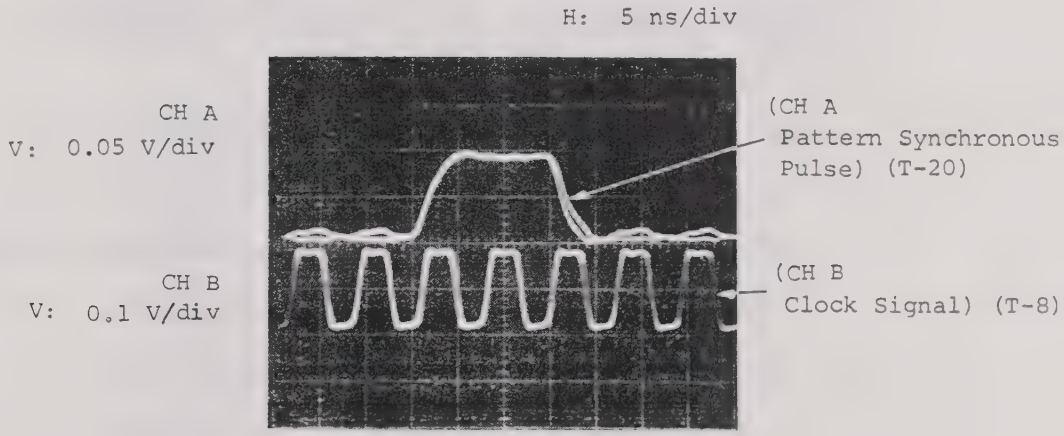


Fig. 6-12 PATTERN SYNC-OUTPUT and CLOCK-OUTPUT Waveforms

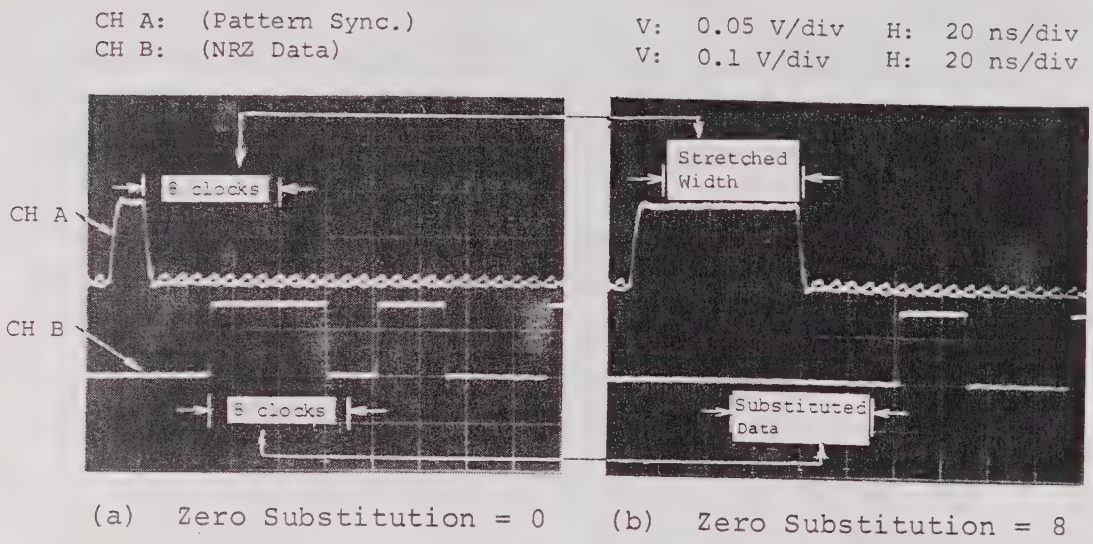


Fig. 6-13 PRBS Zero Substitution Waveform
(CMI NRZ RZ-OUTPUT, T-9)

6.4.6 1-16 bit word pattern check

(1) Specifications

Freely programmable digital word, adjustable length 1 to 16 bit words

(2) Configuration

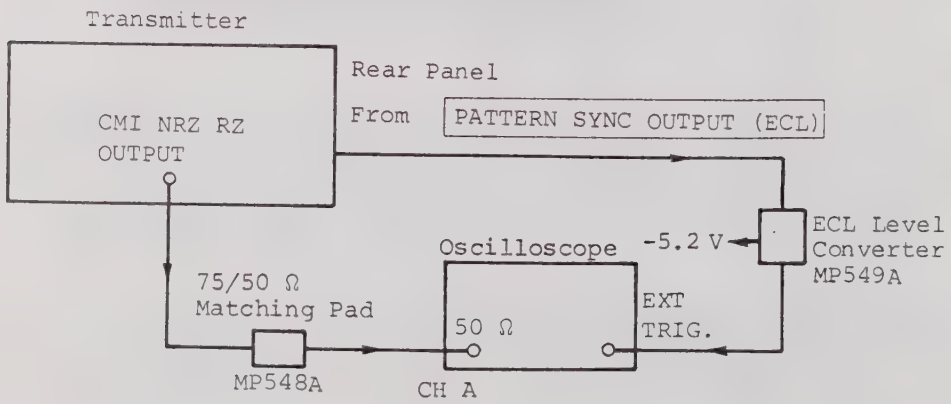
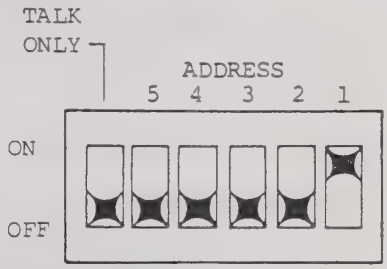


Fig. 6-14 1-16 bit Word Pattern Check

(3) Procedures

An example of word pattern observation with an oscilloscope is shown below.

Step	Procedure	
1	Connect the transmitter as shown in Fig. 6-14.	
2	Set the transmitter controls as follows:	
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)	
b)	BIT RATE kb/s (T-1)	704 (kb/s)
c)	FORMAT (T-1)	NRZ
d)	PATTERN-WORD (T-2)	1-16BIT
e)	ERROR ADDITION [MODE] (T-3)	BIT
f)	ERROR ADDITION [RATE] (T-3)	OFF
g)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
h)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
i)	OUTPUT-NRZ RZ [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

(cont.)

Step	Procedure
3	Set BIT RATE to 68736 (or other setting) with the [BIT RATE kb/s] key.
4	Set word pattern to 1011001111001010 using the [SET 1] and [SET 0] keys.
5	Confirm that the oscilloscope display corresponds to word pattern shown in Fig. 6-15.

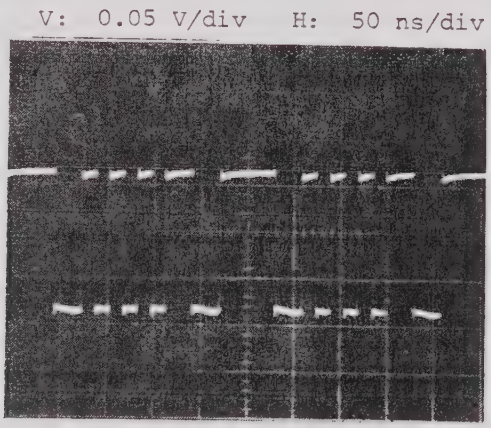


Fig. 6-15 NRZ-Word Pattern (CMI NRZ RZ OUTPUT, T-9)

6.4.7 2x8 bit word pattern check

(1) Specifications

Two 8-bit words, any possible setting, can be changed over by an external control signal

2x8 bit word control signal input (rear panel)

Impedance:	Nominal 1 kΩ unbalanced to ground
Amplitude:	0.25 to 10 Vp-p (sine or square wave), limits ±5 V
Frequency:	Dc to 5 MHz
Negative voltage:	Bits 1 to 8
Positive voltage:	Bits 9 to 16

Internally resolderable to TTL level

Low state:	Bits 1 to 8
High state:	Bits 9 to 16

(2) Configuration

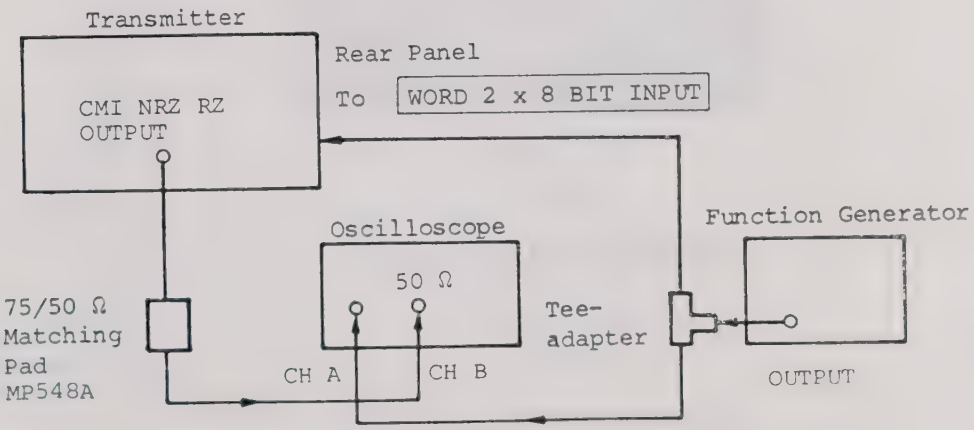
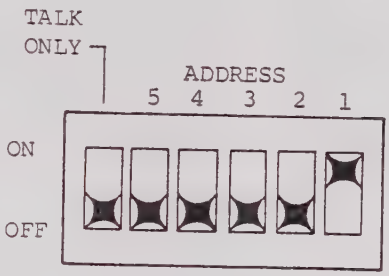


Fig. 6-16 2x8 bit Word Pattern Check

(3) Procedures

Step	Procedure	
1	Connect the transmitter as shown in Fig. 6-16.	
2	Confirm that the transmitter controls are set as follows:	
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)	
b)	BIT RATE kb/s (T-1)	139264 (kb/s)
c)	FORMAT (T-1)	NRZ
d)	PATTERN-WORD (T-2)	2x8 BIT
e)	ERROR ADDITION [MODE] (T-3)	BIT
f)	ERROR ADDITION [RATE] (T-3)	OFF
g)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
h)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
i)	OUTPUT-NRZ RZ [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

(cont.)

Step	Procedure
3	Set the function generator to generate 1 MHz 250 mVp-p square waves for the 2x8-bits word pattern input.
4	Set word pattern to 0000000011111111 using the [SET 1] and [SET 0] keys.
5	Confirm that the oscilloscope display corresponds to the word pattern shown in Fig. 6-17.

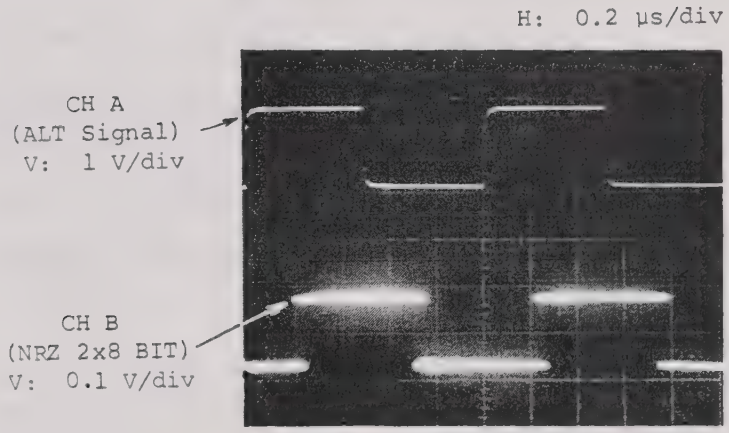


Fig. 6-17 2x8 bit NRZ-Word Pattern
(CMI NRZ RZ-OUTPUT, T-9)

6.4.8 Bit error addition check

(1) Specifications

Bit errors are added to the sending pattern.

Error rate:	10^{-3}, 10^{-4}, 10^{-5} and 10^{-6}
Single error:	1 error is produced for each depression of key.
External error:	Errors are added by external ECL signal.

EXT ERROR input (rear panel)

Impedance:	Nominal 680 Ω unbalanced to -5.2 V
Amplitude:	ECL level
	One error is produced for each positive transition of the external signal.
Frequency:	Dc to 25% of the clock frequency

(2) Configuration

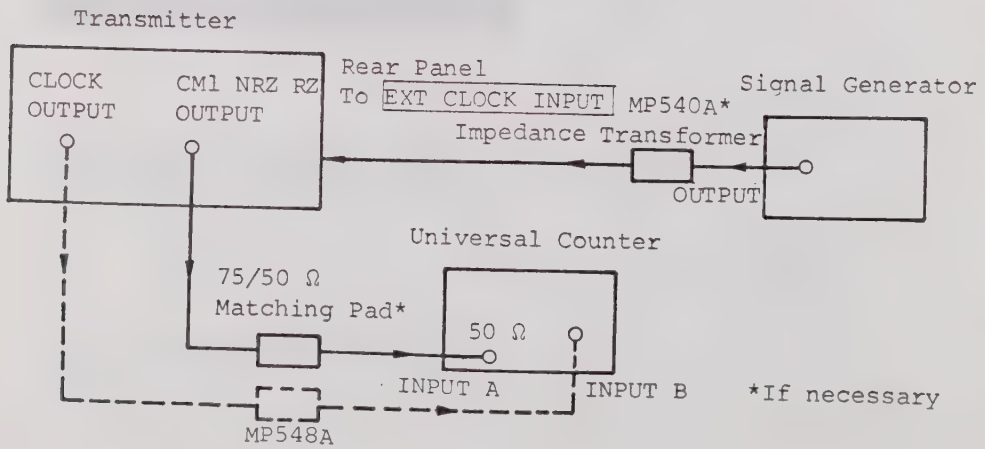
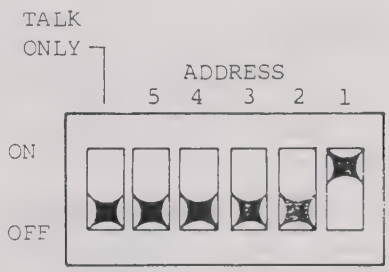


Fig. 6-18 Bit Error Addition Check

(3) Procedures

Single-bit errors are inserted in an all-zero data stream and counted by monitoring the NRZ data output. The bit error rate (1 in 10^3 to 10^6) is also checked using a universal counter. Single-code error insertion is checked using an oscilloscope to monitor polarity inversion in AMI, HDB3, or CMI data output.

Note: Since bit error addition is checked during this performance test, there is no need to check the code error addition because they use the same circuitry.

Step	Procedure
1	Connect the transmitter as shown in Fig. 6-18.
2	Set the transmitter controls as follows:
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.) 
b)	BIT RATE kb/s (T-1) — EXT
c)	FORMAT (T-1) — NRZ
d)	PATTERN-WORD (T-2) — 1-16 BIT
e)	ERROR ADDITION [MODE] (T-3) — BIT
f)	ERROR ADDITION [RATE] (T-3) — OFF

(cont.)

Step	Procedure	
g)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
h)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
i)	OUTPUT-NRZ RZ [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

3 Adjust the controls of the signal generator to generate a 150 MHz (option 02: 170 MHz), greater than the 500 mVp-p signal, at the EXT CLOCK-INPUT connector (rear panel).

Single

4 Set word pattern to 0000000000000000 using the [CLEAR] and [SET 0] keys.

5 Set ERROR ADDITION to SINGLE with [RATE] key.

6 Set the universal counter function switch to START A, and the frequency resolution switch to 1 (1 MHz).

(cont.)

Step	Procedure
7	Press and release the [SINGLE] key twice.
8	Confirm that the universal counter display is correctly incremented each time the key is pressed.
	Error Rate
9	Connect the CLOCK-OUTPUT connector to channel B of the universal counter with a coaxial cable.
10	Set the Universal Counter to measure RATIO B/A and the frequency resolution switch to 10 (0.1 MHz).
11	Set ERROR ADDITION through 10^{-6}, 10^{-5}, 10^{-4}, to 10^{-3} with the [RATE] key.
12	Confirm that the universal counter display corresponds to bit error addition shown in Table 6-6.
	EXT
13	Connect a coaxial cable between the PATTERN SYNC-OUTPUT (ECL) connector (rear panel) and the EXT ERROR-INPUT (ECL) connector (rear panel).
14	Set ERROR ADDITION to EXT with the [RATE] key.
15	Set the PATTERN-word pattern through 0,00,000,0000,---- (pattern length N: 1 up to 16 using the [SET 0] key), and confirm that the universal counter display corresponds to bit error addition shown in Table 6-7.

Table 6-6 Bit Error Addition (Error Rate)

Error Addition Rate	Counter display
10^{-6}	1000000 (±1 count)
10^{-5}	100000 (±1 count)
10^{-4}	10000 (±1 count)
10^{-3}	1000 (±1 count)

Table 6-7 Bit Error Addition (EXT)

Word pattern	Pattern length	Counter display
0	1	4
00	2	4
000	3	6
0000	4	8
.	.	.
.	.	.
.	N	Nx2
.	.	.
.	.	.
0000000000000000	16	32

6.4.9 Code error addition check

(1) Specifications

Code errors are added to the sending pattern.

Error rate:	10^{-3}, 10^{-4}, 10^{-5} and 10^{-6}
Signal error:	1 error is produced for each press of the key.
External error:	Errors are added by external ECL signal.

EXT ERROR input (rear panel)

Impedance:	Nominal 680 Ω unbalanced to -5.2 V
Amplitude:	ECL level
	One error is produced for each positive transition of the external signal.
Frequency:	Dc to 25% of the clock frequency

(2) Configuration

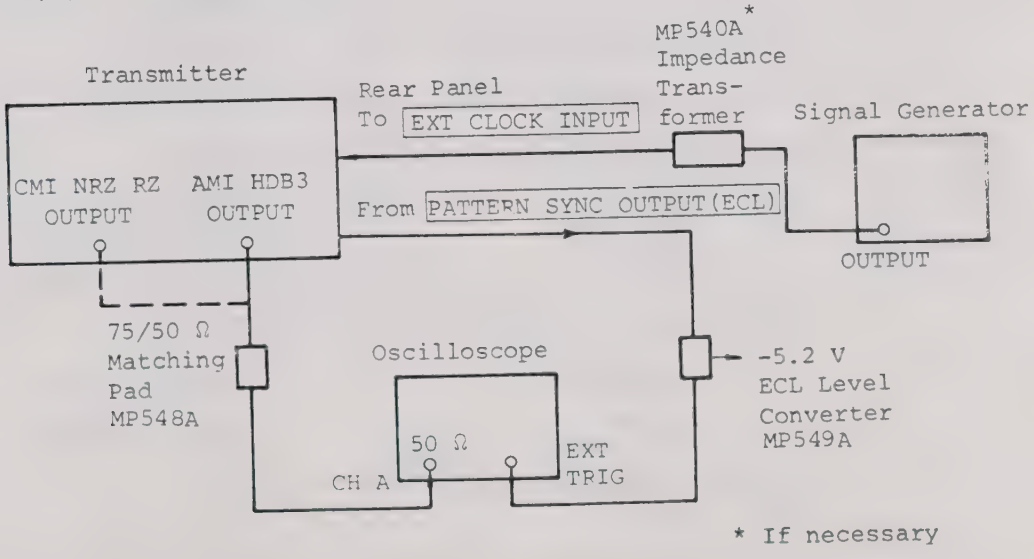
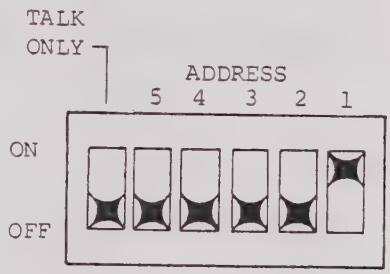


Fig. 6-19 Code Error Addition Check

(3) Procedures

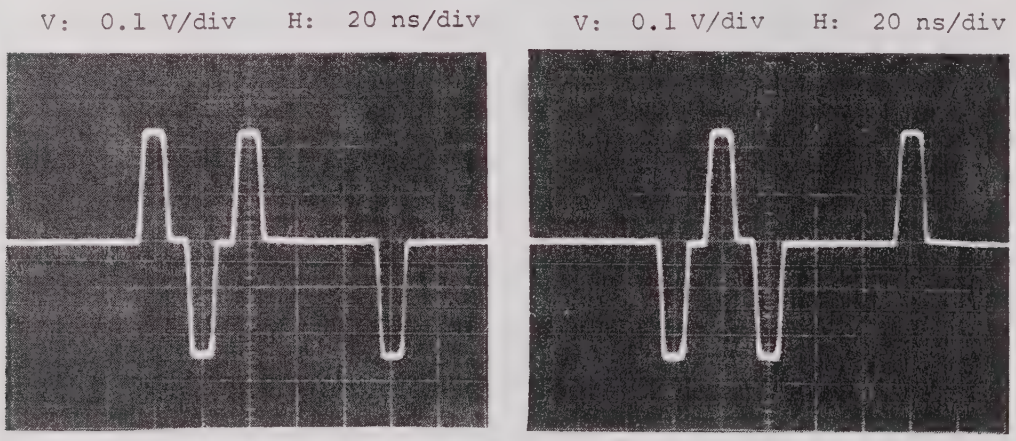
Step	Procedure	
1	Connect the transmitter as shown in Fig. 6-19.	
2	Confirm that the transmitter controls are set as follows:	
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)	
b)	BIT RATE kb/s (T-1)	EXT
c)	FORMAT (T-1)	NRZ
d)	PATTERN-WORD (T-2)	1-16 BIT
e)	ERROR ADDITION [MODE] (T-3)	CODE
f)	ERROR ADDITION [RATE] (T-3)	SINGLE
g)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
h)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
i)	OUTPUT-NRZ RZ [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

(cont.)

Step	Procedure
3	Adjust the signal generator to generate a 50 MHz, and greater than the 300 mVp-p signal output at the EXT CLOCK-INPUT connector (rear panel).
4	Set FORMAT to AMI with the [FORMAT] key.
5	Set word pattern to 1001000011 using the [SET 1] and [SET 0] keys.
6	Press and release the [SINGLE] key repeatedly to confirm whether the waveform polarity is changed on the oscilloscope each time the key is pressed, as shown in Fig. 6-20 (a) and (b).
7	Set FORMAT to HDB3 with the [FORMAT] key.
8	Confirm that the waveform on the oscilloscope changes each time the key is pressed, as shown in Fig. 6-21 (a) and (b).
9	Disconnect coaxial cable from the AMI HDB3-OUTPUT connector and connect it to the CMI NRZ RZ-OUTPUT connector.
10	Set FORMAT to CMI with the [FORMAT] key.

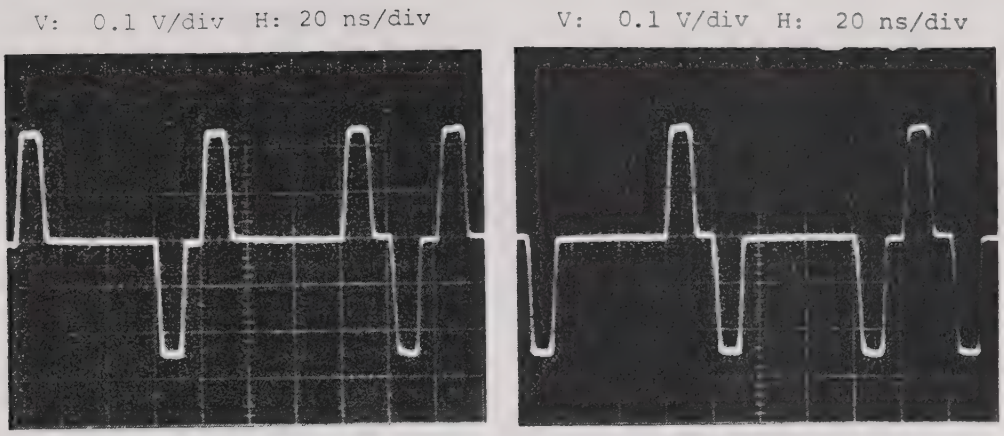
(cont.)

Step	Procedure
11	Adjust the controls of the signal generator to generate a 150 MHz, greater than 300mVp-p, output.
12	Press and release the [SINGLE] key repeatedly, and confirm that the waveform polarity of '1' on the oscilloscope changes each time the key is pressed, as shown in Fig. 6-22 (a) and (b).



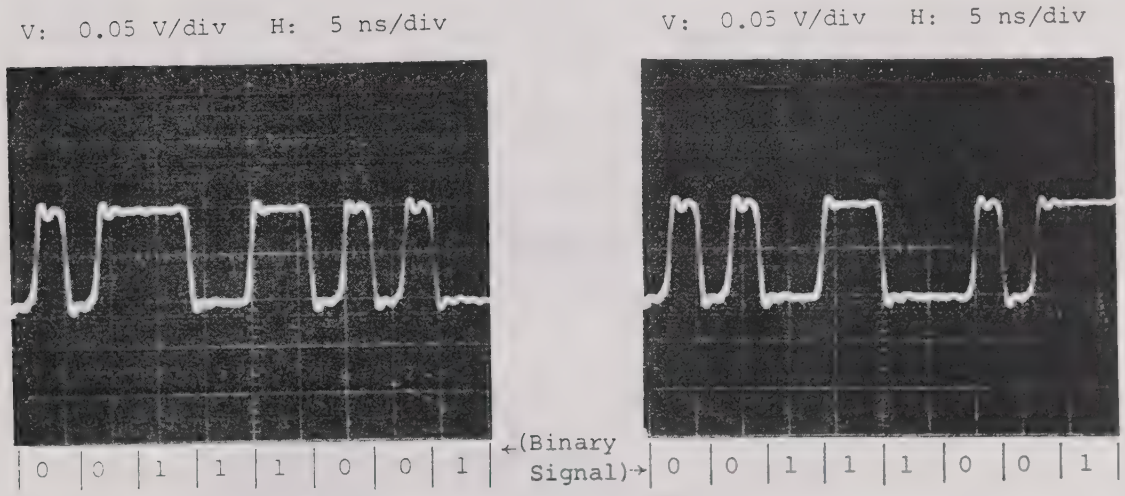
(a) AMI Output (b) Reversed AMI Output

Fig. 6-20 AMI Word Pattern (AMI HDB3-OUTPUT, T-10)



(a) HDB3 Output (b) Reversed HDB3 Output

Fig. 6-21 HDB3 Word Pattern (AMI HDB3-OUTPUT, T-10)



(a) CMI Output (b) Reversed CMI Output

Fig. 6-22 CMI Word Pattern (CMI-OUTPUT, T-9)

6.4.10 AMI, HDB3 output check

(1) Specifications

RZ HDB3 format (CCITT Rec. G.703) or RZ AMI format

Bit rate:	1 kb/s to 50 Mb/s
Level:	Selectable 2.37 ±0.237 V/0 ±0.237 V or 1.0 ±0.1 V/0 ±0.1 V
+ve/-ve (positive/ negative) pulse amplitude ratio:	1.0 ±0.05
Overshoot:	≦10% of pulse amplitude
Numbers:	4 separate buffered outputs, each delayed 4 bits
Impedance:	75 Ω unbalanced

(2) Configuration

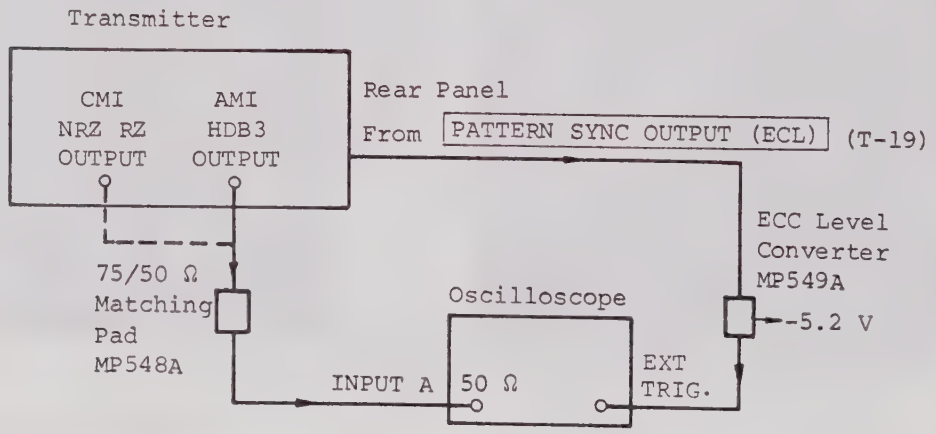
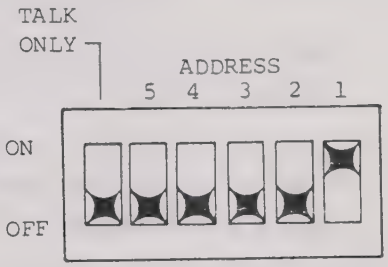


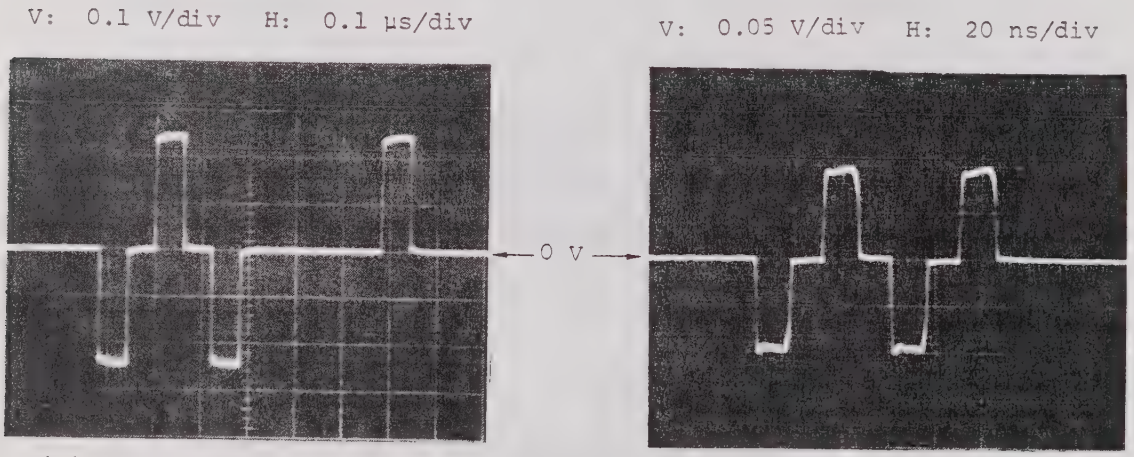
Fig. 6-23 AMI, HDB3 Output Check

(3) Procedures

Step	Procedure	
1	Connect the transmitter as shown by solid line in Fig. 6-23.	
2	Set the transmitter controls as follows:	
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)	
b)	BIT RATE kb/s (T-1)	704 (kb/s)
c)	FORMAT (T-1)	AMI (or HDB3)
d)	PATTERN-WORD (T-2)	1-16 BIT
e)	ERROR ADDITION [MODE] (T-3)	BIT
f)	ERROR ADDITION [RATE] (T-3)	OFF
g)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
h)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
i)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

(cont.)

Step	Procedure
3	Set word pattern to 1100100000100001 (or other setting) using the [SET 1] and [SET 0] keys.
4	Set BIT RATE through 704, 2048, 8448 to 34368 with the [BIT RATE kb/s] key.
5	Set OUTPUT to [2.37 V] (or [1 V]) with the AMI HDB3 [LEVEL] key.
6	Confirm that the oscilloscope display corresponds to the signal shown in Fig. 6-24 (a) and (b).



(a) AMI-OUTPUT Signal
(Output level 2.37 V)

(b) HDB3-OUTPUT Signal
(Output level 1 V)

Fig. 6-24 AMI, HDB3-OUTPUT Patterns
(AMI, HDB3-OUTPUT, T-10)

6.4.11 CMI output check

(1) Specifications

Bit rate: 1 kb/s to 150 Mb/s
Amplitude: 1 ±0.1 Vp-p
Overshoot: ≦5% of measured peak-to-peak voltage
Numbers: 4 separate buffered outputs, common phase

Using internal switch, CMI can be changed to ECL output.

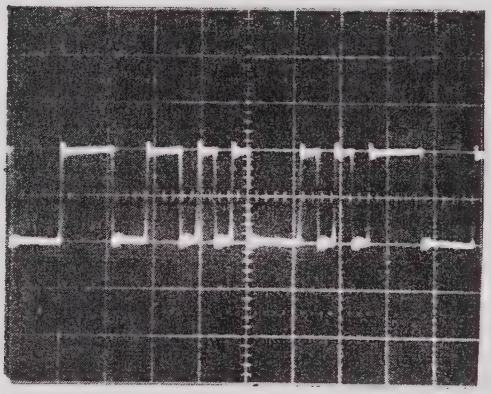
(2) Configuration

Same as that of paragraph 6.4.10 (Fig. 6-23)

(3) Procedures

Step	Procedure
1	Connect the transmitter as shown by dashed line in Fig. 6-23.
2	Press the PATTERN-WORD [1-16 BIT] key.
3	Set word pattern to 10111001000110 (or other setting) using the [SET 1] and [SET 0] keys.
4	Set BIT RATE to 68736 (or 139264) with the [BIT RATE kb/s] key.
5	Set FORMAT to CMI with the [FORMAT] key.
6	Confirm that the oscilloscope display corresponds to the signal shown in Fig. 6-25.

V: 0.05 V/div H: 20 ns/div



Bit Rate =
68736 kb/s

Fig. 6-25 CMI output Pattern (CMI NRZ RZ-OUTPUT, T-9)

6.4.12 NRZ, RZ output check

(1) Specifications

Bit rate:	1 kb/s to 150 Mb/s (Option 02; up to 170 MHz)
Level:	Selectable TTL, ECL or manually SET
TTL:	TTL level (high state = 2.5 V, low state = 0.5 V)
ECL:	ECL level
SET:	Amplitude 1 to 2 V, offset 0 to ±2 V
RZ duty cycle:	50 ±10% on internal clock
NRZ width:	100 ±5%
Overshoot:	≦10% of pulse amplitude
Numbers:	4 separate buffered outputs, each delayed 4 bits
Impedance:	75 Ω, unbalanced
Polarity:	DATA or $\overline{\text{DATA}}$, internally switched at the binary level

(2) Configuration

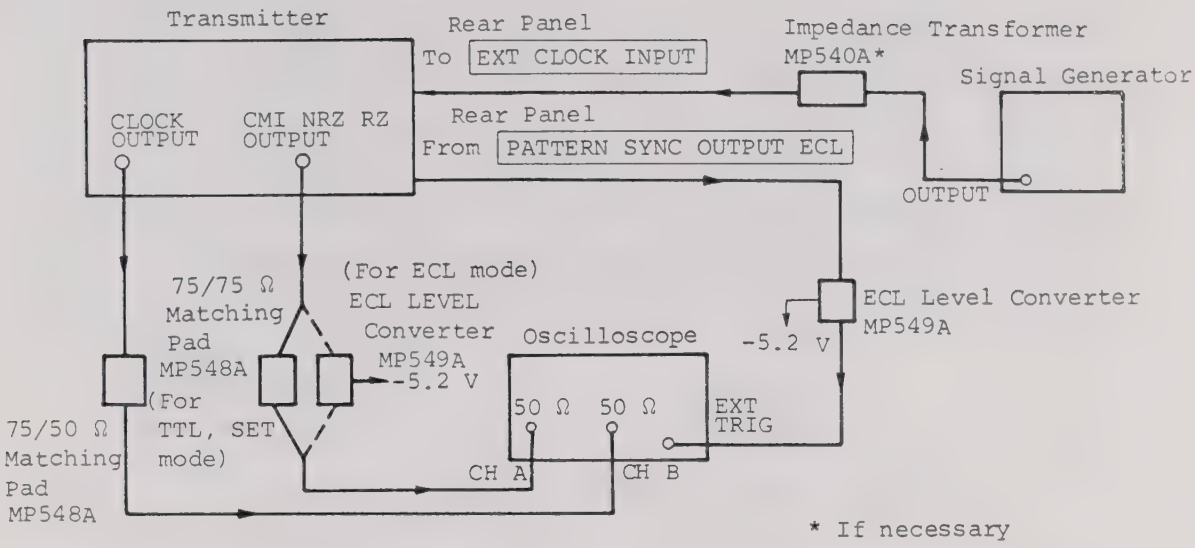


Fig. 6-26 NRZ RZ Output Check

(3) Procedures

Step	Procedure
1	Connect the transmitter as shown in Fig. 6-26.
2	Set the transmitter controls as follows:
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)
b)	BIT RATE kb/s (T-1)

EXT

(cont.)

Step	Procedure	
c)	FORMAT (T-1)	NRZ
d)	PATTERN-WORD (T-2)	1-16 BIT
e)	ERROR ADDITION [MODE] (T-3)	BIT
f)	ERROR ADDITION [RATE] (T-3)	OFF
g)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
h)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
i)	OUTPUT-NRZ RZ [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

3 Set word pattern to 101010 .... (or any other one to sixteen pattern) using the [SET 1] and [SET 0] keys.

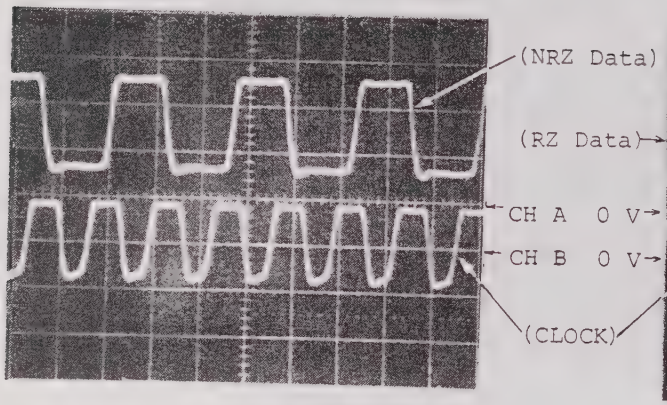
4 Input the signal shown below at the EXT CLOCK-INPUT connector (rear panel).

Frequency: 150 MHz (170 MHz when Option 02 is installed)
Level: 0 dBm (typical)
Waveform: Sine wave

(cont.)

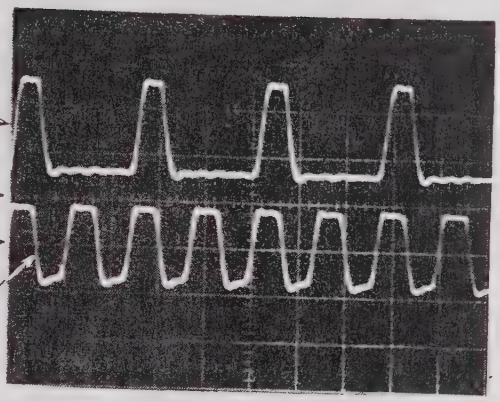
Step	Procedure
	Output Level TTL
5	Set OUTPUT to TTL with the NRZ RZ [LEVEL] key.
6	Set the FORMAT to NRZ (or RZ) with the [FORMAT] key.
7	Confirm that the oscilloscope display corresponds to the level shown in Fig. 6-27 (a) and (b) using the 75/50 Ω Matching Pad MP548A.
	Output Level ECL
8	Set the OUTPUT to ECL with the NRZ RZ [LEVEL] key.
9	Set FORMAT to NRZ (or RZ) with the [FORMAT] key.
10	Confirm that the oscilloscope display corresponds to the waveform shown in Fig. 6-28 (a) and (b) using the ECL Level Converter MP549A.
	Output Level SET
11	Set OUTPUT to SET with the NRZ RZ [LEVEL] key.
12	Set FORMAT to NRZ (or RZ) with the [FORMAT] key.
13	Check the following items using the 75/50 Ω Matching Pad MP548A.
	a) Turn the NRZ RZ-LEVEL AMPLITUDE variable resistor with a standard screwdriver, and check that the amplitude (Fig. 6-29 - Va) of the waveform on the oscilloscope can be varied from 1 V to 2 V.
	b) Turn the NRZ RZ-LEVEL OFFSET variable resistor with a standard screwdriver, and check that the dc offset value (Fig. 6-29 - Vo) of the signal on the oscilloscope can be varied over the -2 V to +2 V range.

CH A,B
V: 0.1 V/div H: 5 ns/div



(a) NRZ Data Output
(CMI NRZ RZ-OUTPUT, T-9)

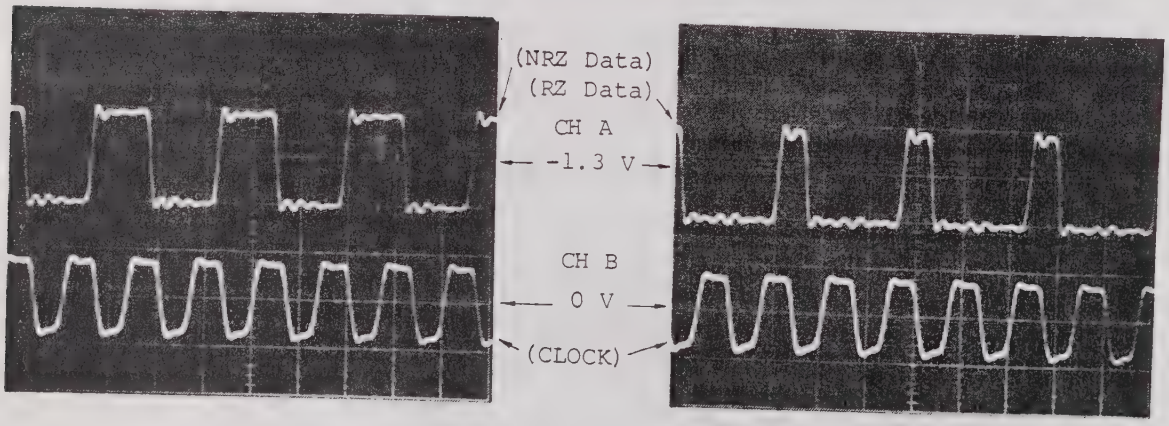
CH A,B
V: 0.1 V/div H: 5 ns/div



(b) RZ Data Output
(CMI NRZ RZ-OUTPUT T-9)

Fig. 6-27 NRZ, RZ Output TTL Patterns
(CMI NRZ RZ-OUTPUT, T-9)

CH A V: 0.05 V/div H: 5 ns/div
CH B V: 0.1 V/div H: 5 ns/div

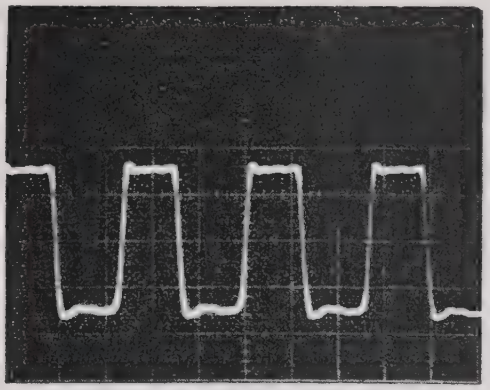


(a) NRZ Data Output
(CMI NRZ RZ-OUTPUT)

(b) RZ Data Output
(CMI NRZ RZ-OUTPUT)

Fig. 6-28 NRZ, RZ Output ECL Pattern
(CMI NRZ RZ-OUTPUT, T-9)

V: 0.05 V/div H: 5 ns/div



(V_0 = -1.5 V
V_a = 1.5 Vp-p)

Fig. 6-29 NRZ-OUTPUT Amplitude/Dc offset Value Check (CMI NRZ RZ-OUTPUT, T-9)

6.4.13 EXT jitter modulation input check

Timing jitter can be added to the clock and data output signals by applying an external modulation source. Peak-to-peak jitter amplitude and modulating frequencies are in accordance with CCITT Recommendation O.171 Table 2 (shown by chain line in Fig. 6-30).

Maximum Jitter Amplitude: 10.10 UI-PP

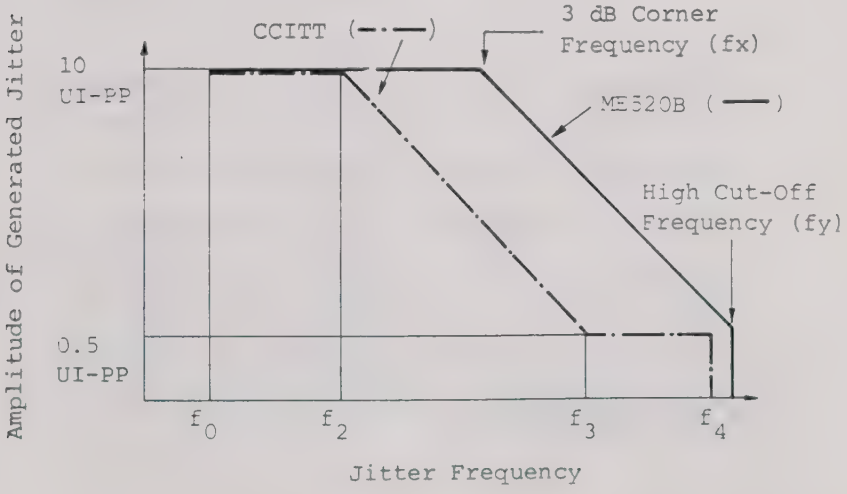


Fig. 6-30 The Relationship between Generated Jitter Amplitude and Jitter Frequency

Table 6-8 Jitter Modulation Frequency

Bit Rate (kb/s)	CCITT Rec. O.171				ME520B	
	f_0 (Hz)	f_2 (kHz)	f_3 (kHz)	f_4 (kHz)	f_x (kHz)	f_y (kHz)
704	-	-	-	-	4.5	35
2048	2	2.4	45	100	13	102
8448	2	10.7	200	400	50	422
34368	2	1.0	20	800	210	1,000
68736	-	-	-	-	300	2,000
139264	2	0.5	10	3,500	600	4,000
EXT	Can be modulated at internal rates ±10%					

(1) Specifications

Frequency Range:	Meets CCITT Rec. O.171, Table 2 for sinusodial modulation; typically dc to 5% or 2.5% of bit rate, shown in above figure and table
Impedance:	Nominal 75 Ω unbalanced to ground
Sensitivity:	Nominal 10 UI-PP/V (at 5 Hz)
Display:	0.00 to 10.10 UI-PP
Display Accuracy:	±5% ±0.1 UI-PP
	Valid for periodic modulating frequencies down to 5 Hz.

(2) Configuration

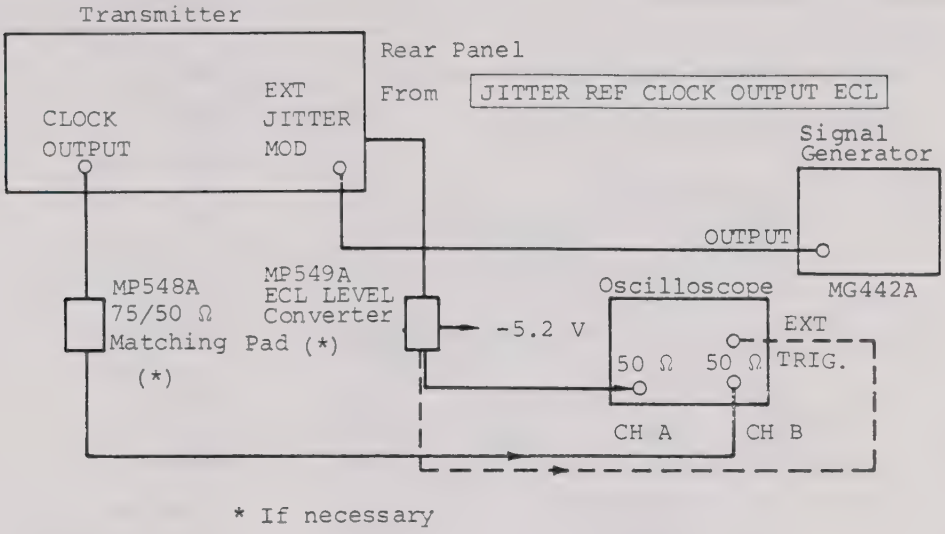
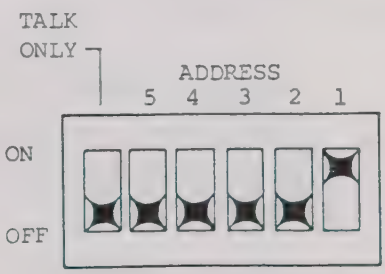


Fig. 6-31 EXT Jitter Modulation Input Check

(3) Procedures

The reference CLOCK-OUTPUT outputs a clock signal which is not jitter modulated.

Step	Procedure
1	Connect the transmitter as shown in Fig. 6-31.
2	Set the transmitter controls as follows:
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)
b)	BIT RATE kb/s (T-1)



704 (kb/s)

(cont.)

Step	Procedure	
c)	FORMAT (T-1)	NRZ
d)	PATTERN-PRBS (T-2)	$2^{10}-1$
e)	PATTERN-PRBS ZERO SUBSTITUTION (T-2)	OFF
f)	ERROR ADDITION [MODE] (T-3)	BIT
g)	ERROR ADDITION [RATE] (T-3)	OFF
h)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
i)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	OUTPUT-NRZ RZ [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
k)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

3 Set BIT RATE to 68736 (or other setting) with the [BIT RATE kb/s] key.

4 Set FREQ OFFSET/JITTER MOD to JITTER MOD with the [MODE] key.

5 Set the signal generator frequency to 1 kHz. Adjust the signal generator output to obtain a JITTER MOD value of [0.5 UI-PP] (example).

6 Confirm that the oscilloscope display corresponds to the signal shown in Fig. 6-32.

(cont.)

Step	Procedure
7	Disconnect the coaxial cable from oscilloscope channel A connector, then connect it to EXT TRIG-input connector.
8	Switch the oscilloscope TRIG mode to EXT.
9	Set the signal generator to 1 kHz with 0 V output.
10	Adjust the oscilloscope to display 3.5 complete cycles of the CLOCK-OUTPUT connector signal as shown in Fig. 6-33.
11	Increase the signal generator output until the oscilloscope display is similar to the waveform shown in Fig. 6-34 (a).
12	Confirm that the JITTER MOD display indicates 0.50 ±0.12 (accuracy of ±0.5% ±0.1 UI-PP).
13	Increase the signal generator output until the oscilloscope display is similar to the waveform shown in Fig. 6-34 (b).
14	Confirm whether the JITTER MOD display indicates 1.00 ±0.15. (accuracy = ±5% ±0.1 UI-PP).
15	Increase the signal generator output until the oscilloscope display is similar to the waveform shown in Fig. 6-34 (c).

(cont.)

Step	Procedure
16	Confirm that the transmitter JITTER MOD display indicates 1.50 ±0.17 (accuracy = ±5% ±0.1 UI-PP).
17	Increase the signal generator output until the oscilloscope display is similar to the waveform shown in Fig. 6-34 (d).
18	Confirm that the JITTER MOD display indicates 2.00 ±0.20 (accuracy = ±5% ±0.1 UI-PP).
19	As the signal generator output increases, the oscilloscope display should become similar to the waveforms shown in Figs. 6-33, 6-34 (c), and (d), respectively, with the sequence being repeated.
20	Increase the signal generator output until an oscilloscope display, similar to the waveform shown in Fig. 6-34 (d), is obtained at the fifth time from zero modulation.
21	Confirm that the JITTER MOD display indicates between 9.40 and 10.23 UI-PP.

CH A (JITTER REF
CLOCK-OUTPUT, T-19)

CH B (CLOCK-OUTPUT, T-8)

CH A,B V: 0.1 V/div
H: 5 ns/div

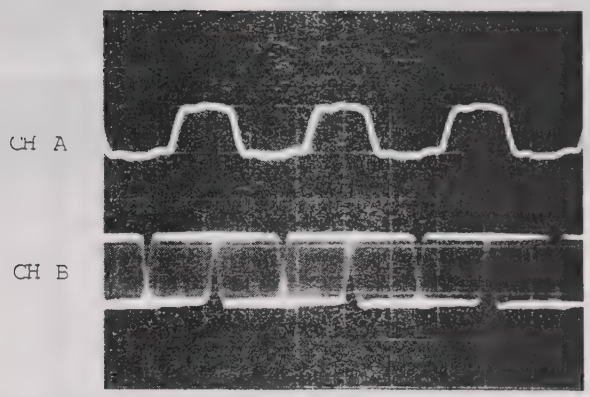


Fig. 6-32 Reference CLOCK-OUTPUT and Modulated CLOCK-OUTPUT Waveform

V: 0.05 V/div H: 5 ns/div

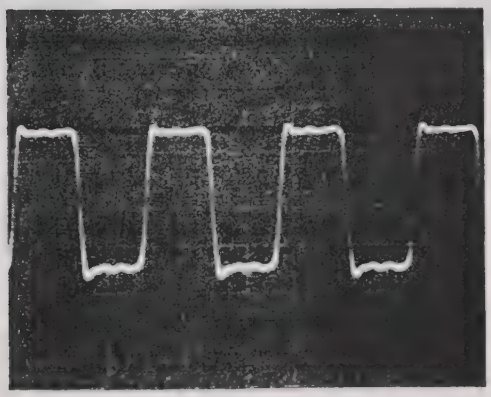
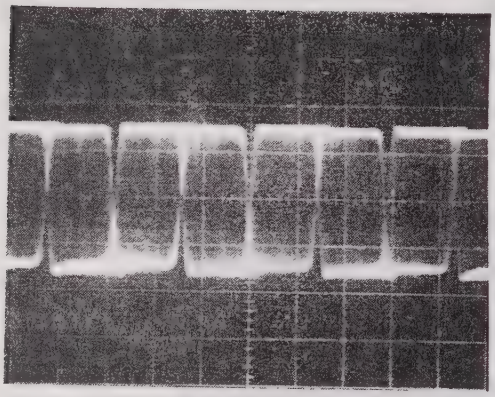
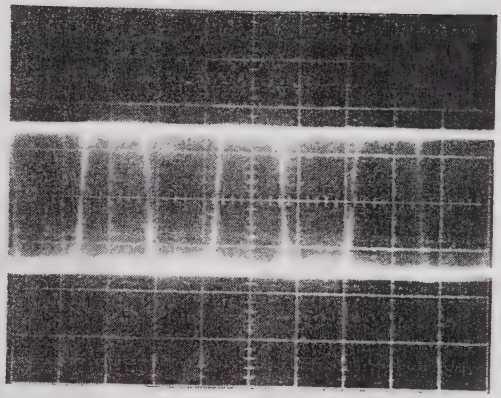


Fig. 6-33 3.5 Clock Periods of CLOCK-OUTPUT (T-8)

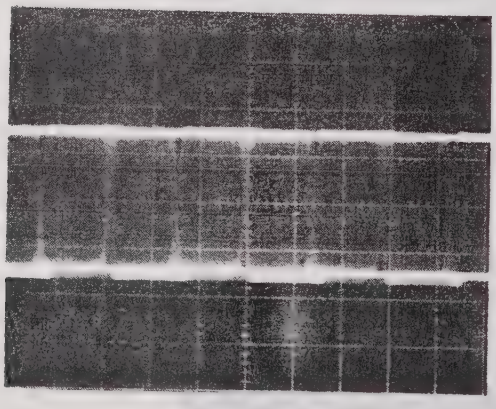
(a) to (d) V: 0.05 V/div H: 5 ns/div



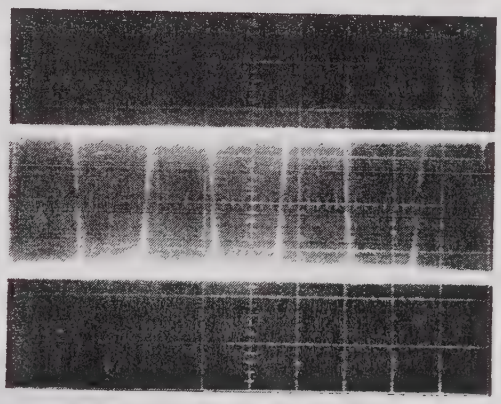
(a) 0.5 UI-PP Jitter



(b) 1 UI-PP Jitter



(c) 1.5 UI-PP Jitter



(d) 2.0 UI-PP Jitter

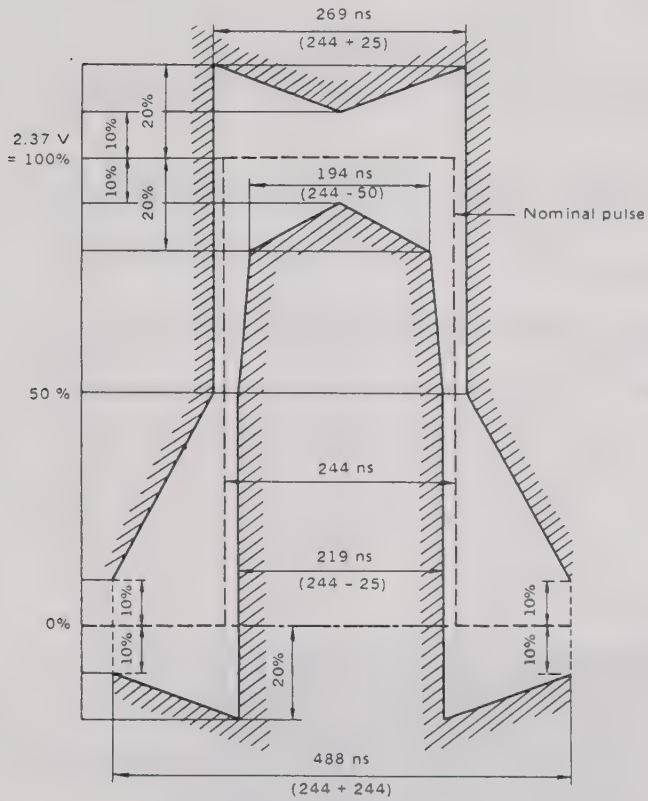
Fig. 6-34 3.5 Clock Periods
(CLOCK-OUTPUT, T-8)

6.4.14 2048 kb/s HDB3 pulse characteristics check

(1) Specifications (CCITT Rec. G.703)

+ve/-ve pulse amplitude ratio: 1.0 ±0.05

Pulse shape: Fig. 6-35



+Ve pulse mask and
-Ve pulse mask are
symmetrical about
GND electric potential
(0 V)

Fig. 6-35 Pulse Mask at the 2048 kb/s HDB3

(2) Configuration

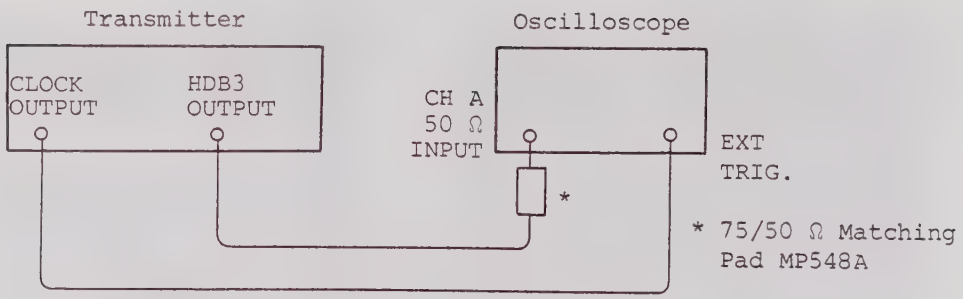
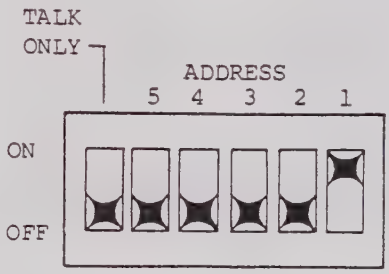


Fig. 6-36 2048 kb/s HDB3 Pulse Characteristics Check

(3) Procedures

Step	Procedure	
1	Connect the transmitter as shown in Fig. 6-36.	
2	Set the transmitter controls as follows:	
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)	
b)	BIT RATE kb/s (T-1)	2048 (kb/s)
c)	FORMAT (T-1)	HDB3
d)	PATTERN-PRBS (T-2)	$2^{15}-1$
e)	PATTERN-PRBS ZERO SUBSTITUTION (T-2)	OFF
f)	ERROR ADDITION [MODE] (T-3)	BIT
g)	ERROR ADDITION [RATE] (T-3)	OFF

(cont.)

Step	Procedure	
h)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
i)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF
3	Confirm that the oscilloscope display corresponds to the waveform shown in Fig. 6-37.	
4	Confirm that +ve/-ve pulse amplitude ratio is 1.0 ±0.05.	
5	Confirm that pulse mask specifications in Fig. 6-35 are met.	

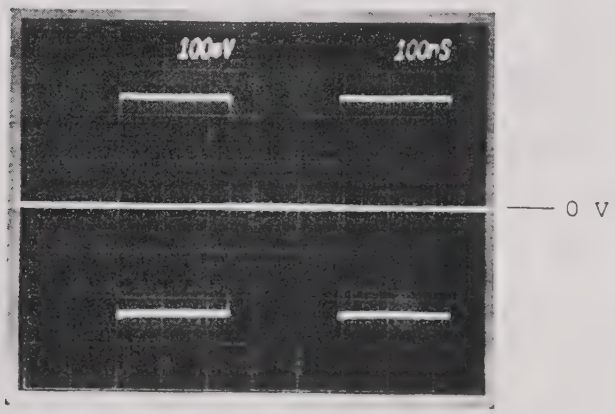


Fig. 6-37 2048 kb/s HDB3 Waveform

6.4.15 8448 kb/s HDB3 pulse characteristics check

(1) Specifications (CCITT Rec. G.703)

+ve/-ve pulse amplitude ratio: 1.0 ±0.05

Pulse shape: Fig. 6-38

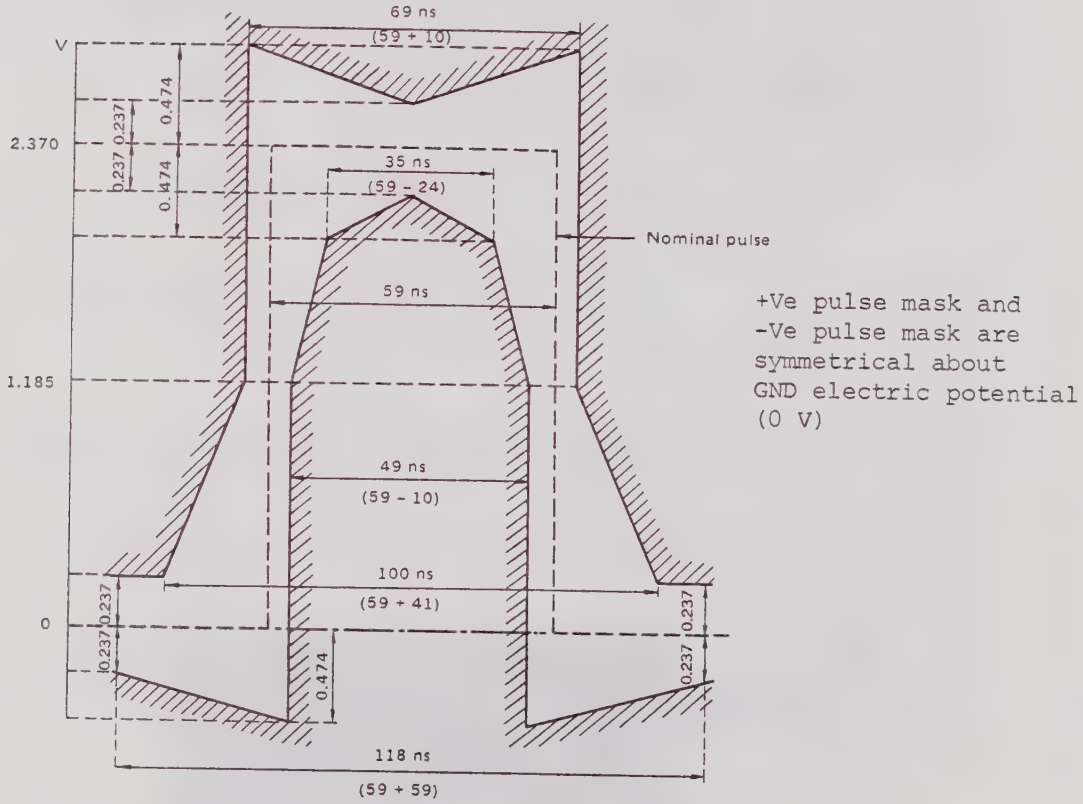


Fig. 6-38 Pulse Mask at the 8448 kb/s HDB3

(2) Configuration

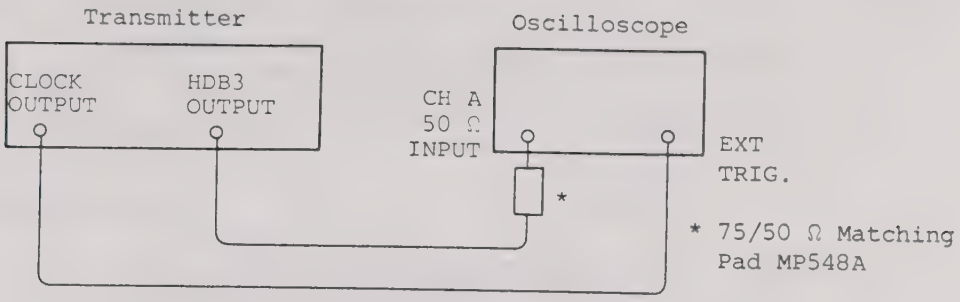
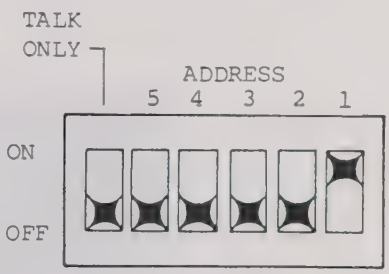


Fig. 6-39 8448 kb/s HDB3 Pulse Characteristics Check

(3) Procedures

Step	Procedure	
1	Connect the transmitter as shown in Fig. 6-39.	
2	Set the transmitter controls as follows:	
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)	
b)	BIT RATE kb/s (T-1)	8448 (kb/s)
c)	FORMAT (T-1)	HDB3
d)	PATTERN-PRBS (T-2)	$2^{15}-1$
e)	PATTERN-PRBS ZERO SUBSTITUTION (T-2)	OFF
f)	ERROR ADDITION [MODE] (T-3)	BIT
g)	ERROR ADDITION [RATE] (T-3)	OFF

(cont.)

Step	Procedure	
h)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
i)	OUTPUT-CLOCK [LEVEL] (T-4)	
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

3 Confirm that the oscilloscope display corresponds to the waveform shown in Fig. 6-40.

4 Confirm that +ve/-ve pulse amplitude ratio is 1.0 ±0.05.

5 Confirm that pulse mask specifications in Fig. 6-38 are met.

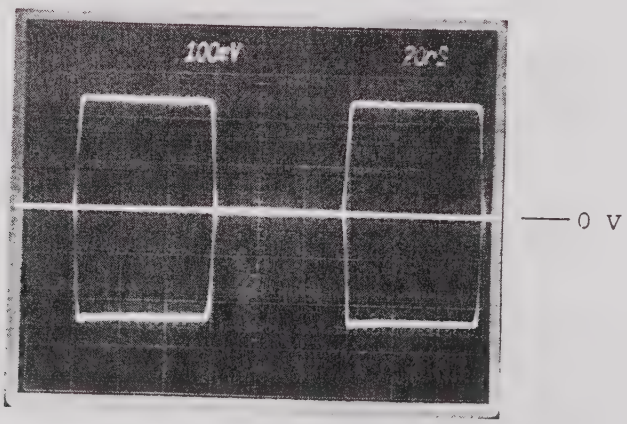


Fig. 6-40 8448 kb/s HDB3 Waveform

6.4.16 34368 kb/s HDB3 pulse characteristics check

(1) Specifications (CCITT Rec. G.703)

+ve/-ve pulse amplitude ratio: 1.0 ±0.05

Pulse shape: Fig. 6-41

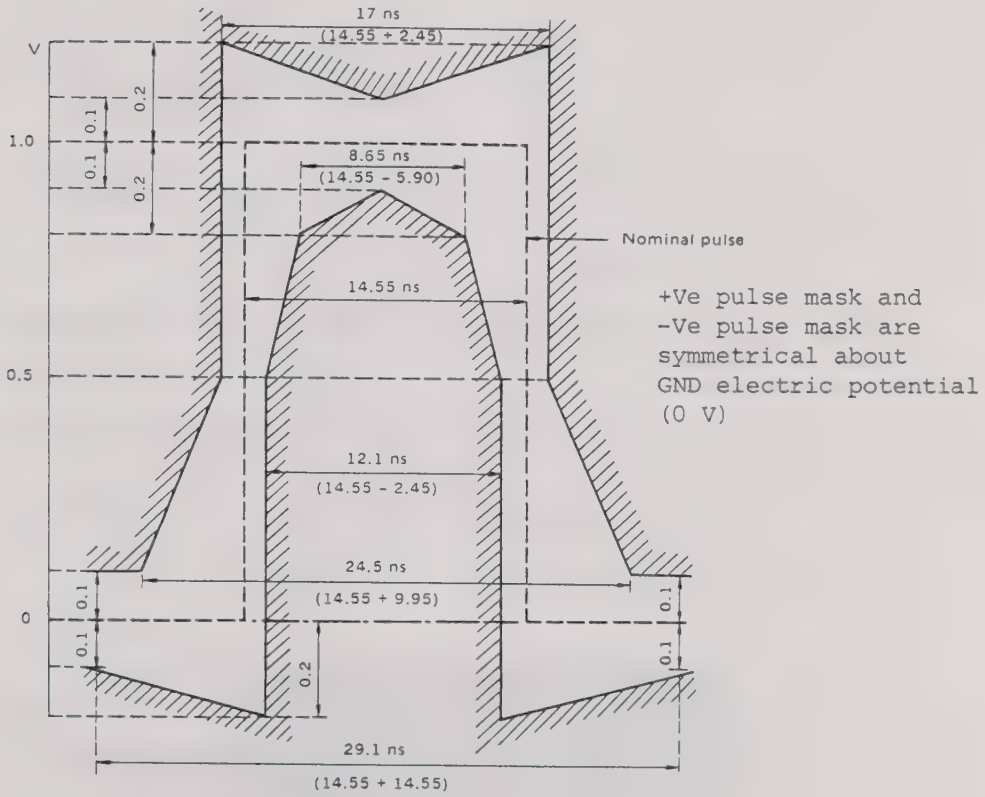


Fig. 6-41 Pulse Mask at the 34368 kb/s HDB3

(2) Configuration

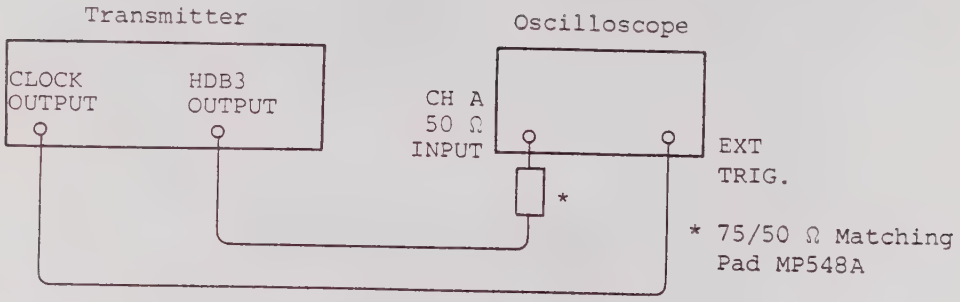
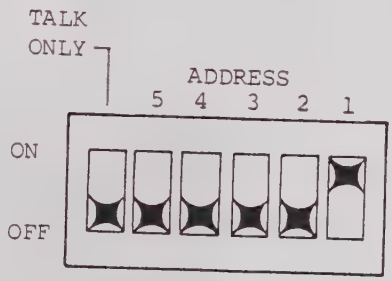


Fig. 6-42 34368 kb/s HDB3 Pulse Characteristics Check

(3) Procedures

Step	Procedure	
1	Connect the transmitter as shown in Fig. 6-42.	
2	Set the transmitter controls as follows:	
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)	
b)	BIT RATE kb/s (T-1)	34368 (kb/s)
c)	FORMAT (T-1)	HDB3
d)	PATTERN-PRBS (T-2)	$2^{23}-1$
e)	PATTERN-PRBS ZERO SUBSTITUTION (T-2)	OFF
f)	ERROR ADDITION [MODE] (T-3)	BIT
g)	ERROR ADDITION [RATE] (T-3)	OFF

(cont.)

Step	Procedure	
h)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
i)	OUTPUT-CLOCK [LEVEL] (T-4)	SET
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

3 Confirm that the oscilloscope display corresponds to the waveform shown in Fig. 6-43.

4 Confirm that +ve/-ve pulse amplitude ratio is 1.0 ±0.05.

5 Confirm that pulse mask specifications in Fig. 6-41 are met.

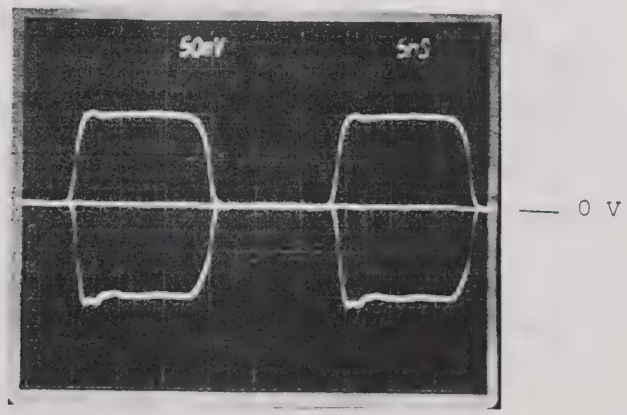


Fig. 6-43 34368 kb/s HDB3 Waveform

6.4.17 139264 kb/s CMI pulse characteristics check

(1) Specifications (CCITT Rec. G.703)

Overshoot: ≤5% of measured p-p voltage

Amplitude: 1.0 ±0.1 Vp-p

Pulse shape: Fig. 6-44

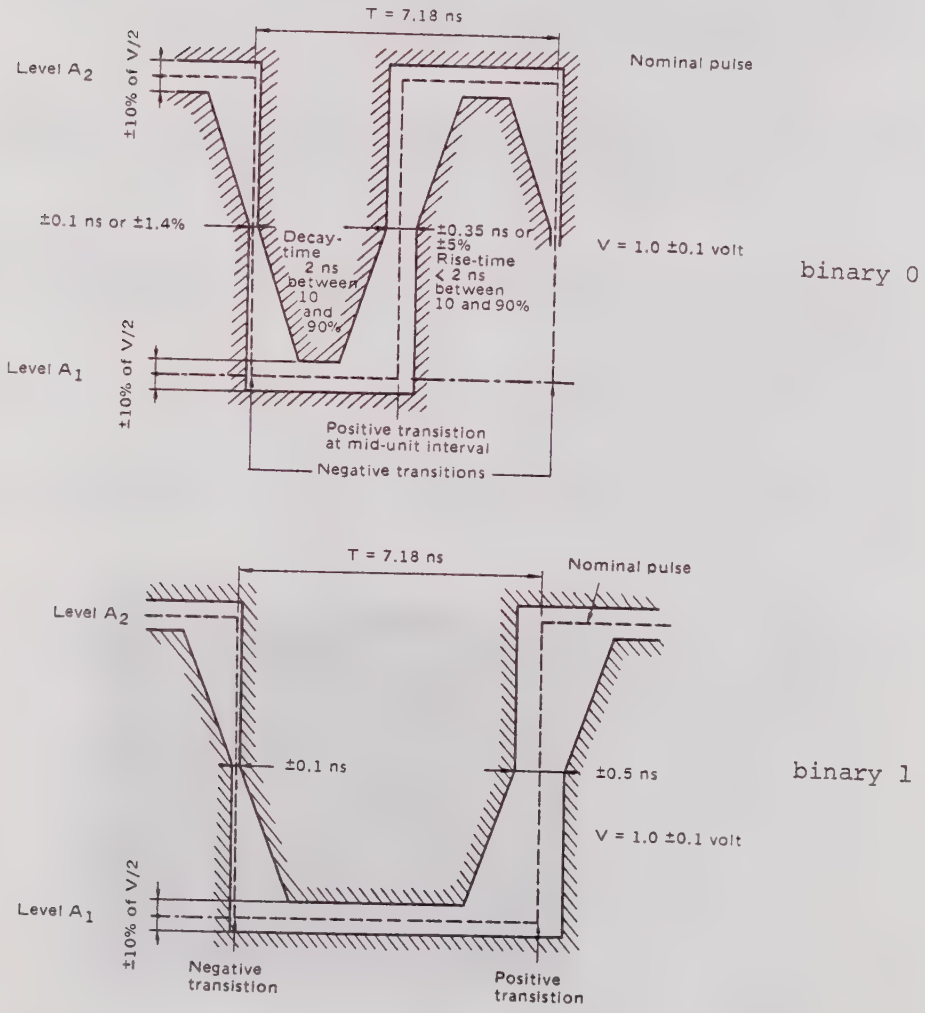


Fig. 6-44 Pulse Mask at the 139264 kb/s CMI

(2) Configuration

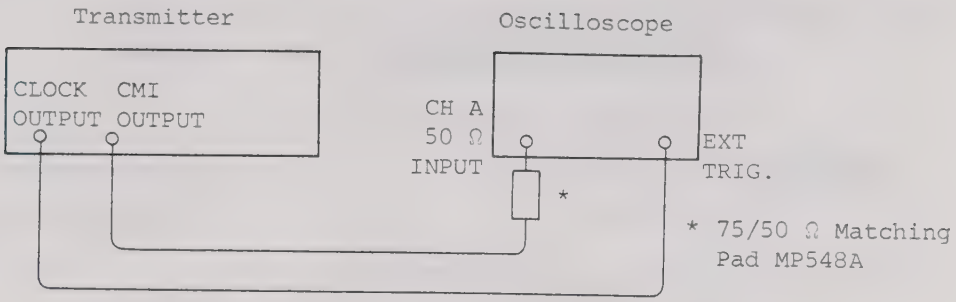
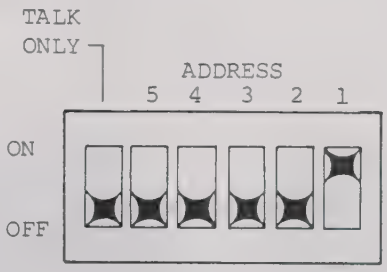


Fig. 6-45 139264 kb/s CMI Pulse Characteristics Check

(3) Procedures

Step	Procedure	
1	Connect the transmitter as shown in Fig. 6-45.	
2	Set the transmitter controls as follows:	
a)	ADDRESS setting (rear panel, T-14) (This switch must be set when the ac power is OFF.)	
b)	BIT RATE kb/s (T-1)	139264 (kb/s)
c)	FORMAT (T-1)	CMI
d)	PATTERN-PRBS (T-2)	$2^{23}-1$
e)	PATTERN-PRBS ZERO SUBSTITUTION (T-2)	OFF
f)	ERROR ADDITION [MODE] (T-3)	BIT
g)	ERROR ADDITION [RATE] (T-3)	OFF

(cont.)

Step	Procedure	
h)	OUTPUT-CLOCK [POLARITY] (T-4)	CLOCK
i)	OUTPUT-CLOCK [LEVEL] (T-4)	
	AMPLITUDE	slot vertical
	OFFSET	slot vertical
j)	FREQ OFFSET/JITTER MOD [MODE] (T-5)	OFF

3 Confirm that the oscilloscope display corresponds to the waveform shown in Fig. 6-46.

4 Confirm that the overshoot does not exceed 5% of the measured p-p voltage.

5 Confirm that the amplitude is 1 ±0.1 Vp-p.

6 Confirm that the pulse mask specifications in Fig. 6-44 are met.

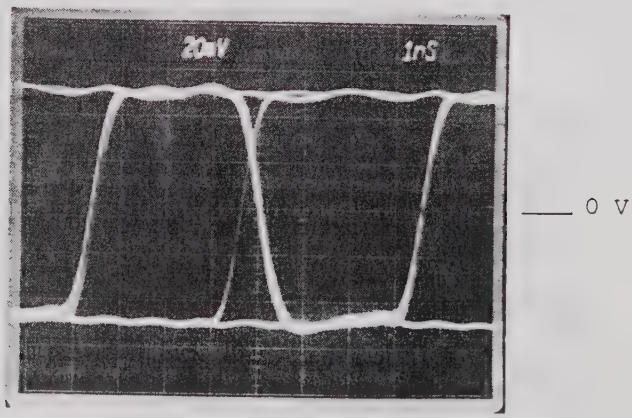
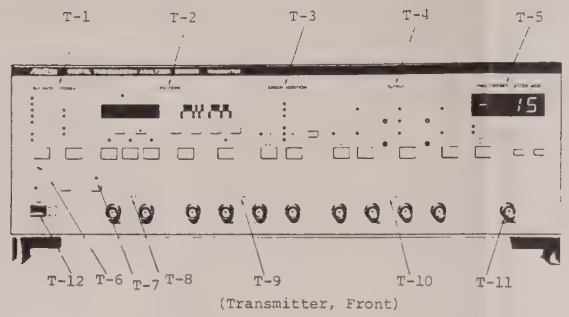
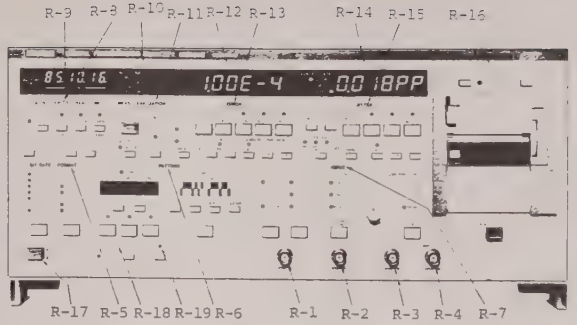


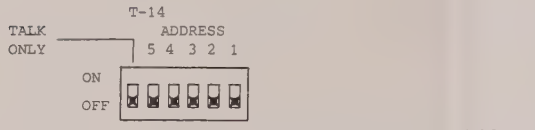
Fig. 6-46 139264 kb/s CMI Waveform

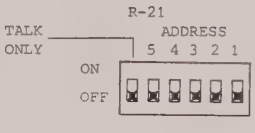


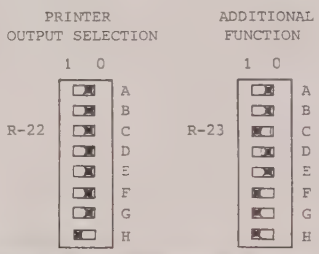
(Transmitter, Front)

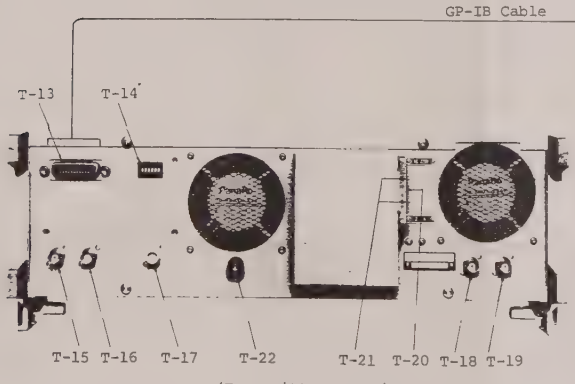


(Receiver, Front)

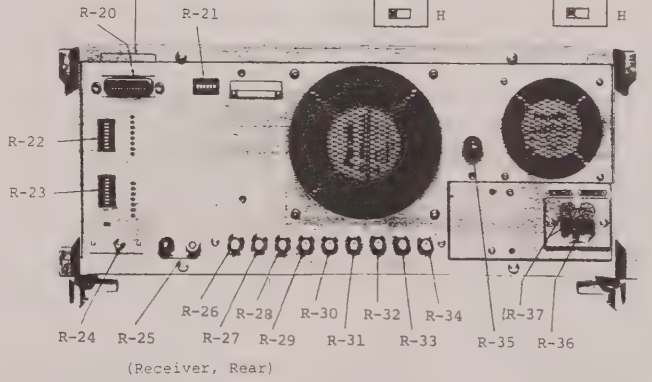








(Transmitter, Rear)



(Receiver, Rear)

Fig. 6-47 Reference Settings

6.5 Receiver Performance Check

6.5.1 AMI, HDB3 input check (For TERM mode)

(1) Specifications

Input: Ac coupled (1 μF)

Impedance: 75 Ω unbalanced

Amplitude: Automatic $\sqrt{f}$ equalization

Table 6-9 Receiver AMI, HDB3-INPUT Amplitude

Bit Rate (kb/s)	Nominal Peak Voltage of a Mark (pulse)	Nominal Voltage of a Space (no pulse)	Maximum $\sqrt{f}$ loss at 1/2 Bit Rate
704	2.37 V	0 V	3 dB
2048	2.37 V	0 V	6 dB
8448	2.37 V	0 V	6 dB
34368	1.0 V	0 V	12 dB

Recover rate: 704, 2048, 8448, 34368 (kb/s)

Pulling Range:

Bit rate (kb/s)	AMI	HDB3
704	±100 ppm	±3%
2048	±100 ppm	±3%
8448	±100 ppm	±3%
34368	±100 ppm	±3%

(±50 ppm for jitter measurement)

Maximum zeros in pattern with AMI:

24 zero substitution in 2^{15}-1 PRB3 pattern

PRBS pattern

2^{10}-1:	Inverted signal
2^{15}-1:	Inverted signal, CCITT Rec. O.151
2^{23}-1:	Inverted signal, CCITT Rec. O.151

Zero substitution (PRBS only)

The sequence can be disabled for 8 to 120 clock periods, in multiples of 8 clock periods. Zero substitution gating occurs in every sequence after the longest zero sequence in a PRBS pattern.

1-16 bit word pattern:

Freely programmable digital word, adjustable length 1 to 16 bits

(2) Configuration

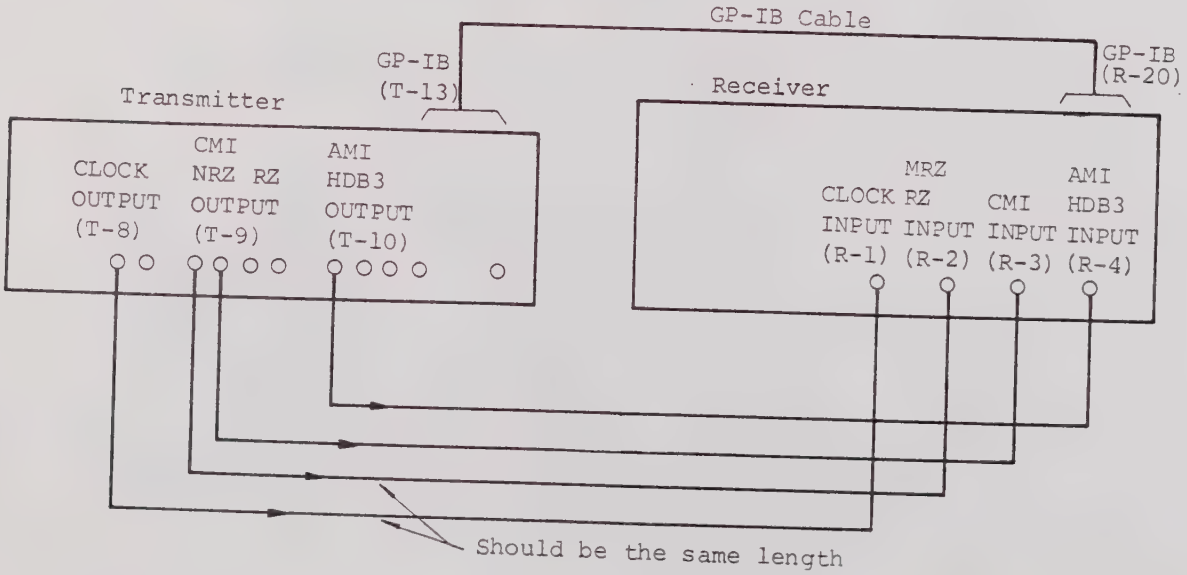


Fig. 6-48 AMI, HDB3 Input Check (For TERM Mode)

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient.
	Set the references as follows:
	(1) Turn off the ME520B(T)/(R) power switch. (T-12, R-17)
	(2) Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)
	(3) Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)
	(4) Turn on the ME520B(T) power switch. (T-12)
	(5) Turn on the ME520B(R) power switch. (R-17)
	(6) Set the ME520B(T) control switches as shown below. (See Fig. 6-47)
	a) BIT RATE kb/s (in T-1) — 704 (kb/s)
	b) FORMAT (in T-1) — AMI (or HDB3)
	c) PATTERN (in T-2) — PRBS, $[2^{10}-1]$
	d) ZERO SUBSTITUTION (in T-2) — [OFF] (0 position)
	e) ERROR ADDITION
	MODE (in T-3) — BIT
	RATE (in T-3) — OFF
	f) CLOCK
	POLARITY (in T-4) — CLOCK
	LEVEL (in T-4) — ECL

(cont.)

Step	Procedure	
	g) AMI HDB3 LEVEL (in T-4)	2.37 V
	h) FREQ OFFSET/JITTER MOD (in T-5)	OFF
(7)	Set the ME520B(R) control switches as shown below. (See Fig. 6-47) However, do not operate the switches whose settings are linked with the transmitter settings.	
	a) INPUT Mode (CMI, AMI, HDB3) (in R-7)	TERM
	b) GATING PERIOD Mode (in R-8)	[MAN]
	c) MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
	d) ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
	e) JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
	f) JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-48.	

(cont.)

Step	Procedure
3	Set transmitter PATTERN-PRBS ZERO SUBSTITUTION to [X] (X: 0 to 24 for AMI FORMAT, or 0 to 120 for HDB3 FORMAT) with the [⩓] key.
4	Set the transmitter BIT RATE sequentially through 704, 2048, 8448, and 34368 with the [BIT RATE kb/s] key.
5	Press the receiver MEASURE [START/STOP] key each time the BIT RATE is changed, and confirm that the receiver ERROR display indicates 0.
6	Set the transmitter ERROR ADDITION to BIT (or CODE) with the [MODE] key, and to 10^{-3} (or other setting) with the [RATE] key.
7	Press the receiver ERROR-DISPLAY MODE [ERROR RATE] key.
8	Set receiver BIT RATE through 704, 2048, 8448, and 34368 the same as in step 4 with the [BIT RATE] key.
9	Press the receiver MEASURE [START/STOP] key each time BIT RATE is changed, and confirm that the receiver ERROR display indicates 9.99E-4 or 1.00E-3 (if an ERROR ADDITION other than 10^{-3} is set in step 6, ERROR display changes accordingly.)
10	Set the transmitter ERROR ADDITION to OFF with the [RATE] key.

(cont.)

Step	Procedure
11	Press the receiver ERROR-DISPLAY MODE [ERROR COUNT] key.
12	Repeat steps 4 to 11.
13	Press the transmitter PATTERN-PRBS [2^{15}-1] key, and repeat steps 3 to 12.
14	Press the transmitter PATTERN-PRBS [2^{23}-1] key, and repeat steps 3 to 12.
15	Press the transmitter PATTERN-WORD [1-16 BIT] key, and set an arbitrary word pattern using the [SET 1] and [SET 0] keys. However, when FORMAT is set to HDB3 and ERROR ADDITION is set to CODE, always set so that the word pattern contains four or more consecutive zeros. A word pattern that does not contain four or more consecutive zeros will not generate an HDB3 code error. (Testing with an arbitary word pattern is possible in BIT or CODE error measurement in AMI format, and BIT error measurement in HDB3 format.)
16	Repeat steps 4 to 12.

6.5.2 AMI, HDB3 input check (For MON mode)

(1) Specifications

Additional gain: 30 dB for 704, 2048, 8448 kb/s

26 dB for 34368 kb/s

(2) Configuration

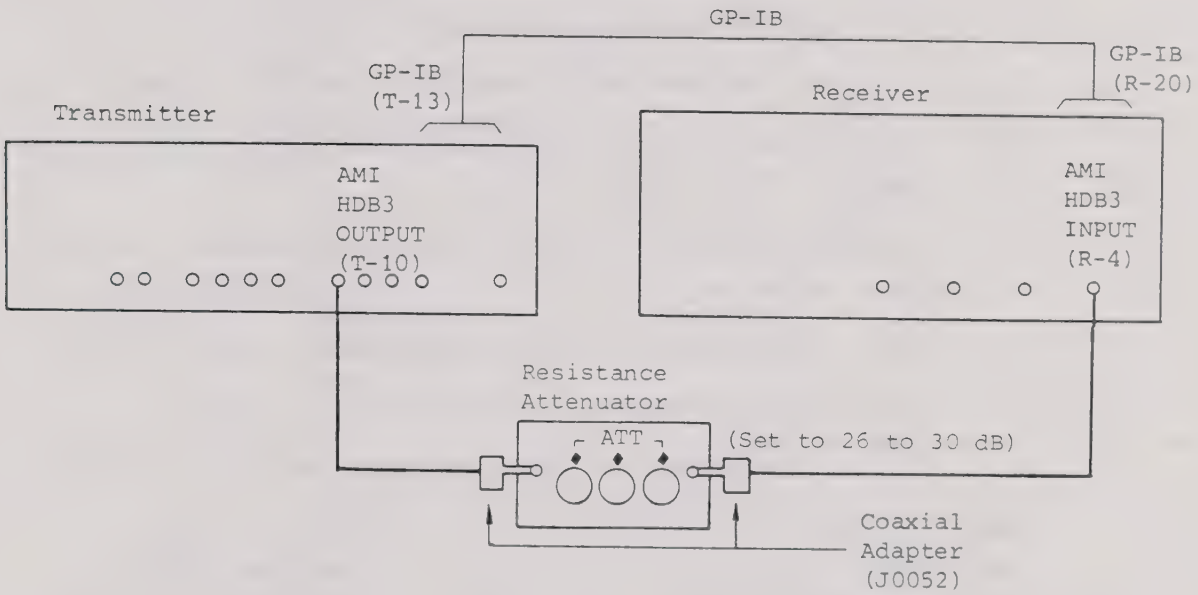


Fig. 6-49 AMI/HDB3 Input Check (For MON Mode)

(3) Procedures

Step	Procedure
1.	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient.
	Set the references as follows:
(1)	Turn off the ME520B(T)/(R) power switch. (T-12, R-17)
(2)	Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)
(4)	Turn on the ME520B(T) power switch. (T-12)
(5)	Turn on the ME520B(R) power switch. (R-17)
(6)	Set the ME520B(T) control switches as shown below.
a)	BIT RATE kb/s (in T-1) — 704 (kb/s)
b)	FORMAT (in T-1) — AMI (or HDB3)
c)	PATTERN (in T-2) — PRBS, $[2^{10}-1]$
d)	ZERO SUBSTITUTION (in T-2) — [OFF] (0 position)
e)	ERROR ADDITION
	MODE (in T-3) — BIT
	RATE (in T-3) — OFF
f)	CLOCK
	POLARITY (in T-4) — CLOCK
	LEVEL (in T-4) — ECL

(cont.)

Step	Procedure	
g)	AMI HDB3 LEVEL (in T-4)	2.37 V
h)	FREQ OFFSET/JITTER MOD (in T-5)	OFF
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
a)	INPUT Mode (CMI, AMI, HDB3) (in R-7)	MON
b)	GATING PERIOD Mode (in R-8)	[MAN]
c)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
d)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
e)	JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
f)	JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-49.	

(cont.)

Step	Procedure
3	Set transmitter PATTERN-PRBS ZERO SUBSTITUTION to [X] (X: 0 to 24 for AMI FORMAT, or 0 to 120 for HDB3 FORMAT) with the [⩓] key.
4	Set transmitter BIT RATE through 704, 2048, 8448, and 34368 with the [BIT RATE kb/s] key (set the resistance attenuator value for each bit rate value as shown in Table 6-10).
5	Press the receiver MEASURE [START/STOP] key each time BIT RATE is changed, and confirm that the receiver ERROR display indicates 0.
6	Set the transmitter ERROR ADDITION to BIT (or CODE) with the [MODE] key, and to 10^{-3} (or other setting) with the [RATE] key.
7	Press the receiver ERROR-DISPLAY MODE [ERROR RATE] key.
8	Set receiver BIT RATE through 704, 2048, 8448, and 34368 the same as in step 4 with the [BIT RATE] key.
9	Set the resistance attenuator value for each bit rate value as shown in Table 6-10.

(cont.)

Step	Procedure
10	Press the receiver MEASURE [START/STOP] key each time the BIT RATE is changed, and confirm that the receiver ERROR display indicates 9.99E-4 or 1.00E-3 (if an ERROR ADDITION other than 10^{-3} is set in step 6, ERROR display changes accordingly).
11	Set the transmitter ERROR ADDITION to OFF with the [RATE] key.
12	Press the receiver ERROR-DISPLAY MODE [ERROR COUNT] key.
13	Repeat steps 5 to 12.

Table 6-10 Attenuation and BIT RATE

BIT RATE (kb/s)	Attenuation
704	30 dB
2048	30 dB
8448	30 dB
34368	26 dB

6.5.3 AMI, HDB3 input check (For TERM mode, amplitude equalization)

(1) Specifications

Same as that of paragraph 6.5.1.

(2) Configuration

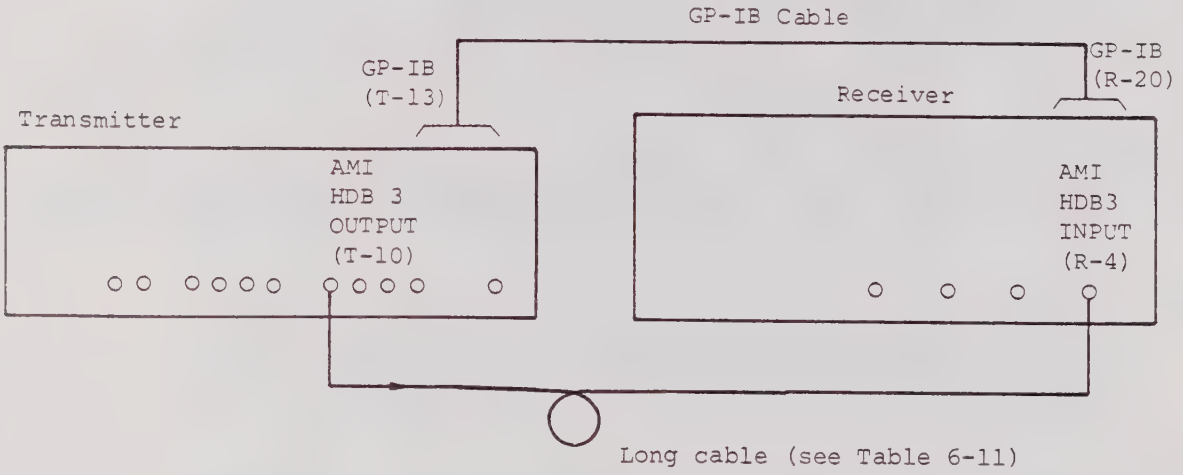


Fig. 6-50 AMI, HDB3 Input Check (For TERM Mode, Amplitude Equalization)

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. Set the references as follows:
(1)	Turn off the ME520B(T)/(R) power switch. (T-12, R-17)
(2)	Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)
(4)	Turn on the ME520B(T) power switch. (T-12)
(5)	Turn on the ME520B(R) power switch. (R-17)
(6)	Set the ME520B(T) control switches as shown below.
a)	BIT RATE kb/s (in T-1) — 704 (kb/s)
b)	FORMAT (in T-1) — AMI (or HDB3)
c)	PATTERN (in T-2) — PRBS, $[2^{10}-1]$
d)	ZERO SUBSTITUTION (in T-2) — [OFF] (0 position)
e)	ERROR ADDITION
	MODE (in T-3) — BIT
	RATE (in T-3) — OFF
f)	CLOCK
	POLARITY (in T-4) — CLOCK
	LEVEL (in T-4) — ECL

(cont.)

Step	Procedure	
g)	AMI HDB3 LEVEL (in T-4)	2.37 V
h)	FREQ OFFSET/JITTER MOD (in T-5)	OFF
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
a)	INPUT Mode (CMI, AMI, HDB3) (in R-7)	TERM
b)	GATING PERIOD Mode (in R-8)	[MAN]
c)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
d)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
e)	JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
f)	JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-50.	

(cont.)

Step	Procedure
3	Set transmitter PATTERN-PRBS ZERO SUBSTITUTION to [X] (X: 0 to 24 for AMI FORMAT, or 0 to 120 for HDB3 FORMAT) with the [^] key.
4	Set the transmitter BIT RATE sequentially through 704, 2048, 8448, and 34368 with the [BIT RATE kb/s] key.
5	Use the 75 Ω coaxial cable shown in Table 6-11 between the transmitter AMI HDB3-OUTPUT connector and the receiver AMI HDB3-INPUT connector.
6	Press the receiver MEASURE [START/STOP] key each time the BIT RATE is changed, and confirm that the receiver ERROR display indicates 0.
7	Set the transmitter ERROR ADDITION to BIT (or CODE) with the [MODE] key, and to 10^{-3} (or other setting) with the [RATE] key.
8	Press the receiver ERROR-DISPLAY MODE [ERROR RATE] key.
9	Set receiver BIT RATE through 704, 2048, 8448, and 34368 the same as in step 4 with the [BIT RATE] key.
10	Press the receiver MEASURE [START/STOP] key each time the BIT RATE is changed, and confirm that the receiver ERROR display indicates 9.99E-4 or 1.00E-3 (if an ERROR ADDITION other than 10^{-3} is set in step 7, ERROR display changes accordingly).

(cont.)

Step	Procedure
11	Set the transmitter ERROR ADDITION to OFF with the [RATE] key.
12	Press the receiver ERROR-DISPLAY MODE [ERROR COUNT] key.
13	Repeat step 4 and steps 6 to 12.
14	Press the transmitter PATTERN-PRBS [2^{15}-1] key, and repeat step 4 and steps 6 to 12.
15	Press the transmitter PATTERN-PRBS [2^{23}-1] key, and repeat step 4 and steps 6 to 12.
16	Press the transmitter PATTERN-WORD [1-16BIT] key, and set an arbitrary word pattern using the [SET 1] and [SET 0] keys. However, when FORMAT is set to HDB3 and ERROR ADDITION is set to CODE, always set so that the word pattern contains four or more consecutive zeros. A word pattern that does not contain four or more consecutive zeros will not generate an HDB3 code error. (Testing with an arbitrary word pattern is possible in BIT or CODE error measurement in AMI format, and BIT error measurement in HDB3 format.)
17	Repeat step 4 and steps 6 to 13.

Table 6-11 Cable length and BIT RATE

BIT RATE (kb/s)	Cable No., Length	Loss at 1/2 Bit Rate
704	No. 2002, 280 m	3 dB
2048	No. 2002, 330 m	6 dB
8448	No. 2003, 250 m	6 dB
34368	No. 2003, 250 m	12 dB

6.5.4 CMI input check (For TERM mode)

(1) Specifications

Threshold: Ground

Termination: Ground

Impedance: 75 Ω unbalanced

Amplitude: Automatic $\sqrt{f}$ equalization

Table 6-12 Receiver CMI Input Amplitude

Bit Rate (kb/s)	Normal Voltage	Maximum $\sqrt{f}$ Loss at 1/2 Bit Rate
68736	1 Vp-p	17 dB
139264*	1 Vp-p	12 dB

* Remove the receiver top cover. Turn the switch on the Z4 INPUT PC board to the $\sqrt{f}$ side.

Recovery rate: 68736, 139264 kb/s

Pulling range:

Bit Rate (kb/s)	CMI
68736	±1%
139264	±3%

(±50 ppm for jitter measurement)

PRBS pattern

2^{10}-1: Inverted signal,
2^{15}-1: Inverted signal, CCITT Rec. O. 151
2^{23}-1: Inverted signal, CCITT Rec. O. 151

Zero substitution (PRBS only)

The sequence can be disabled for 8 to 120 clock periods, in multiples of 8 clock periods. Zero substitution gating occurs in every sequence after the longest zero sequence in a PRBS pattern.

1-16 bit word pattern:

Freely programmable digital word, adjustable length 1 to 16 bits

(2) Configuration

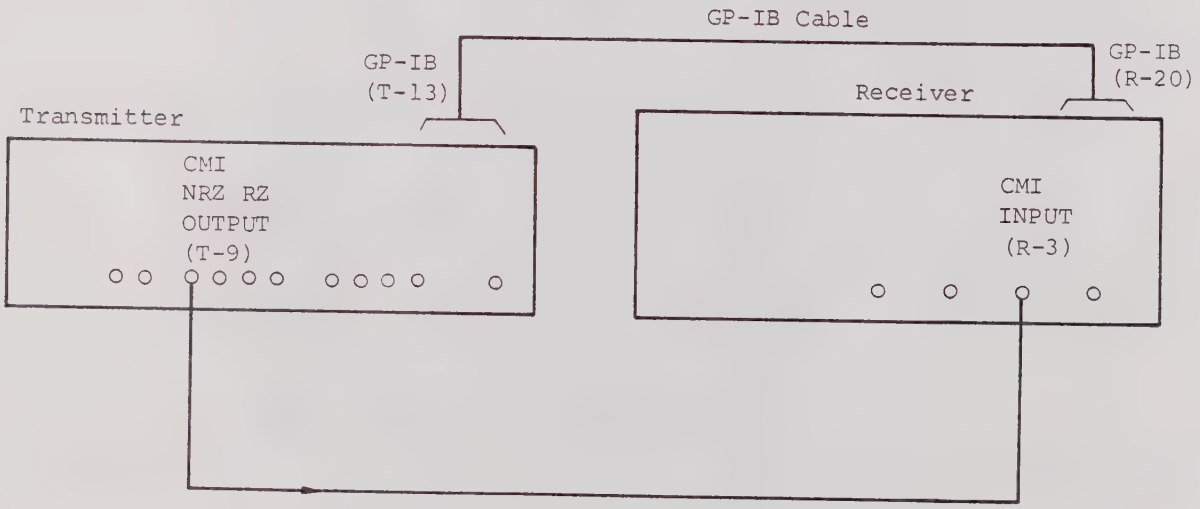


Fig. 6-51 CMI Input Check (For TERM Mode)

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. Set the references as follows: (1) Turn off the ME520B(T)/(R) power switch. (T-12, R-17) (2) Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20) (3) Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-48. (T-14, R-21) (4) Turn on the ME520B(T) power switch. (T-12) (5) Turn on the ME520B(R) power switch. (R-17) (6) Set the ME520B(T) control switches as shown below. a) BIT RATE kb/s (in T-1) — 68736 (kb/s) b) FORMAT (in T-1) — CMI c) PATTERN (in T-2) — PRBS, $[2^{10}-1]$ d) ZERO SUBSTITUTION (in T-2) — [OFF] (0 position) e) ERROR ADDITION MODE (in T-3) — BIT RATE (in T-3) — OFF f) CLOCK POLARITY (in T-4) — CLOCK LEVEL (in T-4) — ECL

(cont.)

Step	Procedure	
g)	FREQ OFFSET/JITTER MOD (in T-5)	OFF
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
a)	INPUT Mode (CMI, AMI, HDB3) (in R-7)	TERM
b)	GATING PERIOD Mode (in R-8)	[MAN]
c)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
d)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
e)	JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
f)	JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-51.	
3	Set transmitter PATTERN-PRBS ZERO SUBSTITUTION to a value within 0 to 120 with the [^] key.	
4	Press the receiver MEASURE [START/STOP] key and confirm that the receiver ERROR display indicates 0.	
5	Set transmitter ERROR ADDITION to BIT (or CODE) with the [MODE] key, and to 10^{-3} (or other setting) with the [RATE] key.	

(cont.)

Step	Procedure
6	Press the receiver ERROR-DISPLAY MODE [ERROR RATE] key.
7	Press the receiver MEASURE [START/STOP] key and confirm that the receiver ERROR display indicates 9.99E-4 or 1.00E-3 (if an ERROR ADDITION other than 10^{-3} is set in step 5, ERROR display changes accordingly).
8	Set transmitter ERROR ADDITION to OFF with the [RATE] key.
9	Press the receiver ERROR-DISPLAY MODE [ERROR COUNT] key.
10	Set the transmitter BIT RATE to 139264 and repeat steps 4 to 9.
11	Press the transmitter PATTERN-PRBS [2^{15}-1] key, and repeat steps 3 to 10.
12	Press the transmitter PATTERN-PRBS [2^{23}-1] key, and repeat steps 3 to 10.
13	Press the transmitter PATTERN-WORD [1-16 BIT] key, set an arbitrary word pattern using the [SET 1] and [SET 0] keys, and repeat steps 4 to 10.

6.5.5 CMI input check (For MON mode)

(1) Specifications

Additional gain: 26 to 30 dB

(2) Configuration

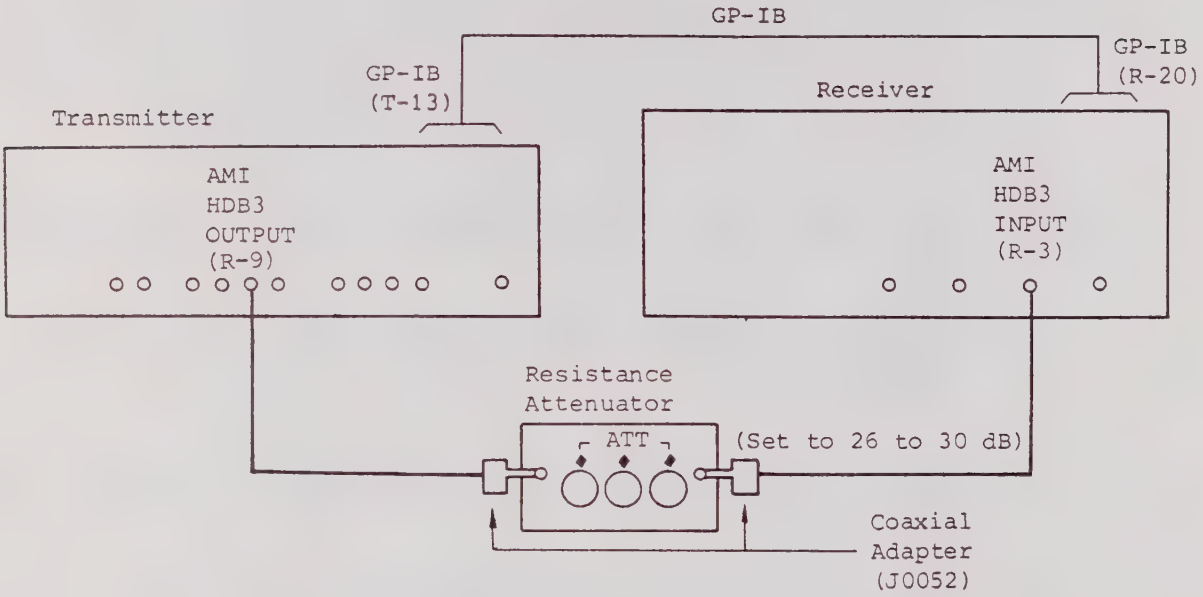


Fig. 6-52 CMI Input Check (For MON Mode)

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient.
	Set the references as follows:
(1)	Turn off the ME520B(T)/(R) power switch. (T-12, R-17)
(2)	Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)
(4)	Turn on the ME520B(T) power switch. (T-12)
(5)	Turn on the ME520B(R) power switch. (R-17)
(6)	Set the ME520B(T) control switches as shown below.
a)	BIT RATE kb/s (in T-1) — 68736 (kb/s)
b)	FORMAT (in T-1) — CMI
c)	PATTERN (in T-2) — PRBS, $[2^{10}-1]$
d)	ZERO SUBSTITUTION (in T-2) — [OFF] (0 position)
e)	ERROR ADDITION
	MODE (in T-3) — BIT
	RATE (in T-3) — OFF
f)	CLOCK
	POLARITY (in T-4) — CLOCK
	LEVEL (in T-4) — ECL
g)	FREQ OFFSET/JITTER MOD (in T-5) — OFF

(cont.)

Step	Procedure	
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
a)	INPUT Mode (CMI, AMI, HDB3) (in R-7)	MON
b)	GATING PERIOD Mode (in R-8)	[MAN]
c)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
d)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
e)	JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
f)	JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]
2.	Connect the transmitter and receiver as shown in Fig. 6-52.	
3	Set transmitter PATTERN-PRBS ZERO SUBSTITUTION to a value within 0 to 120 with the [^] key.	
4	Press the receiver MEASURE [START/STOP] key and confirm that the receiver ERROR display indicates 0.	
5	Set transmitter ERROR ADDITION to BIT (or CODE) with the [MODE] key, and to 10^{-3} (or other setting) with the [RATE] key.	

(cont.)

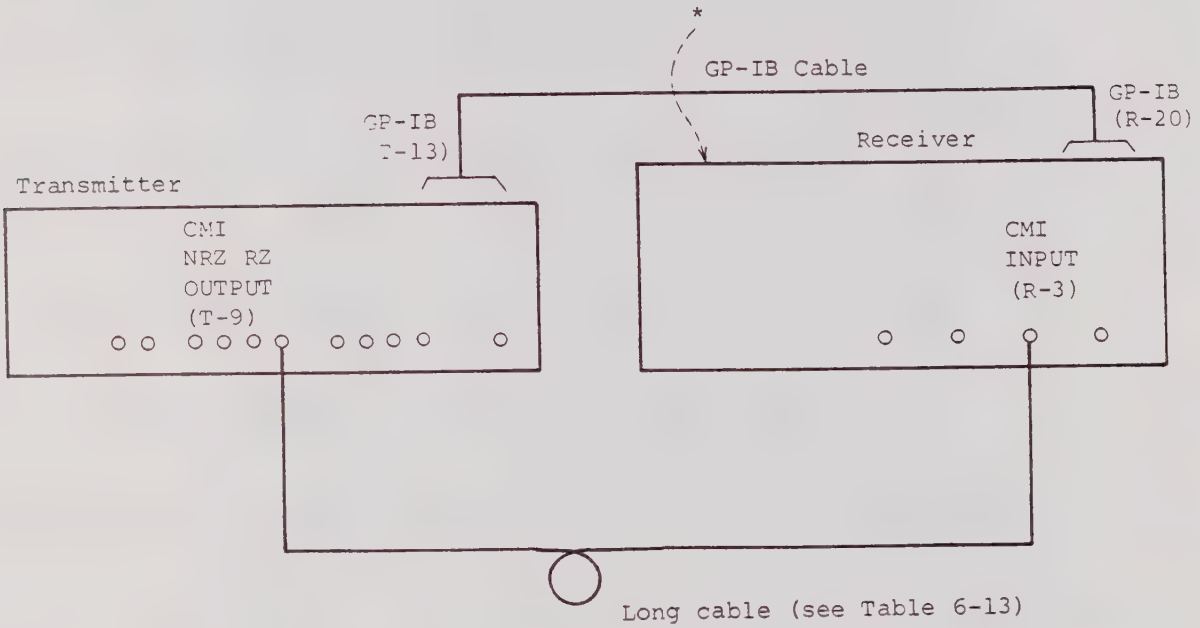
Step	Procedure
6	Press the receiver ERROR-DISPLAY MODE [ERROR RATE] key.
7	Press the receiver MEASURE [START/STOP] key and confirm that the receiver ERROR display indicates 9.99E-4 or 1.00E-3 (if an ERROR ADDITION other than 10^{-3} is set in step 5, ERROR display changes accordingly).
8	Set transmitter ERROR ADDITION to OFF with the [RATE] key.
9	Press the receiver ERROR-DISPLAY MODE [ERROR COUNT] key.
10	Change transmitter BIT RATE to 139264 and repeat steps 4 to 9.

6.5.6 CMI input check (For TERM mode, amplitude equalization)

(1) Specifications

Same as that of paragraph 6.5.4.

(2) Configuration



* Remove the receiver top cover.
Turn the switch on the Z4 INPUT P.C. board to the $\sqrt{f}$ side.

Fig. 6-53 CMI Check (For TERM Mode, Amplitude Equalization)

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient.
	Set the references as follows:
(1)	Turn off the ME520B(T)/(R) power switch. (T-12, R-17)
(2)	Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)
(4)	Turn on the ME520B(T) power switch. (T-12)
(5)	Turn on the ME520B(R) power switch. (R-17)
(6)	Set the ME520B(T) control switches as shown below.
a)	BIT RATE kb/s (in T-1) — 68736 (kb/s)
b)	FORMAT (in T-1) — CMI
c)	PATTERN (in T-2) — PRBS, $[2^{10}-1]$
d)	ZERO SUBSTITUTION (in T-2) — [OFF] (0 position)
e)	ERROR ADDITION
	MODE (in T-3) — BIT
	RATE (in T-3) — OFF
f)	CLOCK
	POLARITY (in T-4) — CLOCK
	LEVEL (in T-4) — ECL
g)	FREQ OFFSET/JITTER MOD (in T-5) — OFF

(cont.)

Step	Procedure

(7) Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.

a)	INPUT Mode (CMI, AMI, HDB3) (in R-7)	TERM
b)	GATING PERIOD Mode (in R-8)	[MAN]
c)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
d)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
e)	JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
f)	JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]

2. Connect the transmitter and receiver as shown in Fig. 6-53.

3 Use the 75 Ω coaxial cable shown in Table 6-13 between the transmitter CMI NRZ RZ-OUTPUT connector and the receiver CMI-INPUT connector.

4 Set transmitter PATTERN-PRBS ZERO SUBSTITUTION to a value within 0 to 120 with the [⩓] key.

5 Press the receiver MEASURE [START/STOP] key and confirm that the receiver ERROR display indicates 0.

(cont.)

Step	Procedure
6	Set transmitter ERROR ADDITION to BIT (or CODE) with the [MODE] key, and to 10^{-3} (or other setting) with the [RATE] key.
7	Press the receiver ERROR-DISPLAY MODE [ERROR RATE] key.
8	Press the receiver MEASURE [START/STOP] key and confirm that the receiver ERROR display indicates 9.99E-4 or 1.00E-3 (if ERROR ADDITION other than 10^{-3} is set in step 6, ERROR display changes correspondingly).
9	Set transmitter ERROR ADDITION to OFF with the [RATE] key.
10	Press the receiver ERROR-DISPLAY MODE [ERROR COUNT] key.
11	Set the transmitter BIT RATE to 139264 and repeat steps 5 to 10.
12	Press the transmitter PATTERN-PRBS [2^{15}-1] key, and repeat steps 4 to 11.
13	Press the transmitter PATTERN-PRBS [2^{23}-1] key, and repeat steps 4 to 11.
14	Press the transmitter PATTERN-WORD [1-16 BIT], set an arbitrary word pattern by using the [SET 1] and [SET 0] keys, and repeat steps 5 to 11.

Table 6-13 Cable Length and BIT RATE

BIT RATE (kb/s)	Cable No., Length	Loss at 1/2 Bit Rate
68736	No. 2003, 250 m	17 dB
139264	No. 2003, 120 m	12 dB

6.5.7 CLOCK input, NRZ RZ input check

(1) Specifications

Clock Input

Polarity:	Selectable CLOCK (positive transition) or $\overline{\text{CLOCK}}$ (negative transition)
Threshold:	Automatic, ground or ECL threshold (coupled with termination switch)
Termination:	Ground or moninal -2 V (via switch)
Frequency:	1 kHz to 150 MHz (Option 02: up to 170 MHz)
Impedance:	75 Ω unbalanced
Amplitude:	0.3 to 3 Vp-p, limits ±3 V

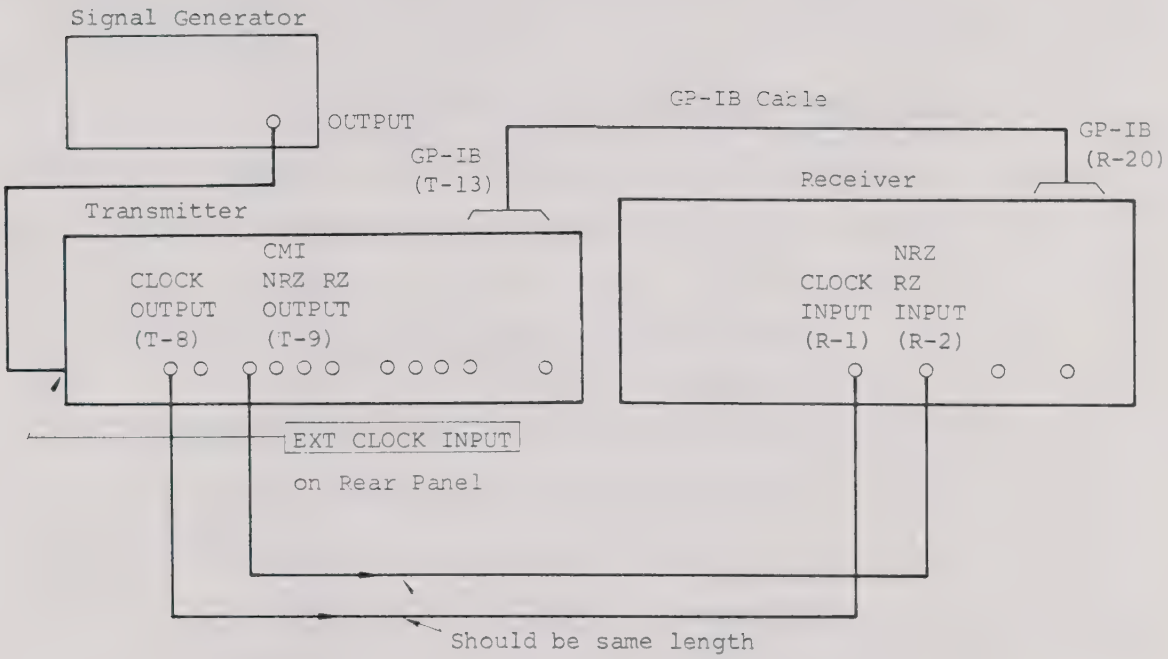
NRZ, RZ Input

Bit rate:	1 kb/s to 150 Mb/s (Option 02: up to 170 MHz)
Threshold:	Manual -3 V to +3 V; ground or ECL threshold (coupled with termination switch)
Termination:	Ground or nominal -2 V (via switch)
Impedance:	75 Ω unbalanced

Amplitude: 0.3 to 3 Vp-p, limits ±3 V

Polarity: DATA or $\overline{\text{DATA}}$, internally switched at binary level

(2) Configuration



Note: The difference in the length of the 75 Ω cables must be less than 10 cm (delay time error 0.5 nsec) or less.

Fig. 6-54 CLOCK Input, NRZ RZ Input Check

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient.
	Set the references as follows:
(1)	Turn off the ME520B(T)/(R) power switch. (T-12, R-17)
(2)	Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)
(5)	Turn on the ME520B(T) power switch. (T-12)
(4)	Turn on the ME520B(R) power switch. (R-17)
(6)	Set the ME520B(T) control switches as shown below.
a)	BIT RATE kb/s (in T-1) — EXT
b)	FORMAT (in T-1) — NRZ (or RZ)
c)	PATTERN (in T-2) — PRBS, $[2^{10}-1]$
d)	ZERO SUBSTITUTION (in T-2) — [OFF] (0 position)
e)	ERROR ADDITION
	MODE (in T-3) — BIT
	RATE (in T-3) — OFF
f)	CLOCK
	POLARITY (in T-4) — CLOCK
	LEVEL (in T-4) — ECL
g)	NRZ RZ LEVEL (in T-4) — ECL
h)	FREQ OFFSET/JITTER MOD (in T-5) — OFF

(cont.)

Step	Procedure

(7) Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.

a)	GATING PERIOD Mode (in R-8)	[MAN]
b)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
c)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
d)	JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
e)	JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]

2 Connect the transmitter and receiver as shown in Fig. 6-54.

3 Set the Signal Generator to give a 150 MHz (option 02: 170 MHz) signal with 0 dBm output level.

4 Set the transmitter PATTERN-PRBS ZERO SUBSTITUTION to a value within 0 to 120 with the [⩓] key.

5 Set the transmitter OUTPUT condition according to Table 6-14.

6 Set the receiver INPUT condition according to Table 6-14.

7 Press the receiver MEASURE [START/STOP] key and confirm that the receiver ERROR display indicates 0.

(cont.)

Step	Procedure
8	Set the transmitter ERROR ADDITION to BIT with the [MODE] key, and to 10^{-3} (or other setting) with the [RATE] key.
9	Press the receiver ERROR-DISPLAY MODE [ERROR RATE] key.
10	Press the receiver MEASURE [START/STOP] key and confirm that the receiver ERROR display indicates 9.99E-4 or 1.00E-3 (if an ERROR ADDITION other than 10^{-3} is set in step 8, the ERROR display changes accordingly).
11	Set transmitter ERROR ADDITION to OFF with the [RATE] key.
12	Press the receiver ERROR-DISPLAY MODE [ERROR COUNT] key.
13	Press the transmitter PATTERN-PRBS [2^{15}-1] key, and repeat steps 4 to 12.
14	Press the transmitter PATTERN-PRBS [2^{23}-1] key, and repeat steps 4 to 12.
15	Press the transmitter PATTERN-WORD [1-16 BIT] key, set an arbitary word pattern using the [SET 1] and [SET 0] keys, and repeat steps 5 to 12.

Table 6-14 ME520B CLOCK, NRZ RZ Data Conditions

Check Item	Transmitter Output Condition		Receiver Input Condition	
CLOCK	POLARITY:	CLOCK	POLARITY:	CLOCK
		$\overline{\text{CLOCK}}$		$\overline{\text{CLOCK}}$
	LEVEL:	TTL	THRESHOLD TERM:	AUTO/GND
		ECL		ECL/-2 V
		SET		AUTO/GND
NRZ RZ	LEVEL:	TTL	LEVEL:	MAN/GND (Set to approximately +1.5 V with the manual setting control.)
		ECL		ECL/-2 V
		SET		MAN/GND (Set to the same voltage as the transmitter dc offset value with the manual setting control.)

6.5.8 REAL TIME setting check

(1) Specifications

Display

YY MM DD or HH MM SS
(Y: Year; M: Month; D: Day;
H: Hour; M: Minute; S: Second)

Setting

Flashing digits can be set higher or lower. When the timer is started by pushing the start button, the timer counts up from 00 seconds. (If the real-time mode is exited without pushing the button, the timer remains at the last count prior to setting.)

Accuracy

±2 ppm at ambient temperature

Stability

Typically ≤ ±5 ppm/0°C to 50°C
Typically ≤ ±2 ppm/year aging
Typically ≤ ±20 ppm/power-down, at 25°C

(2) Configuration

(Note: Settings described in this paragraph are done only on the receiver)

(3) Procedures

Confirm whether the real time measurement described below. See Fig. 6-55.

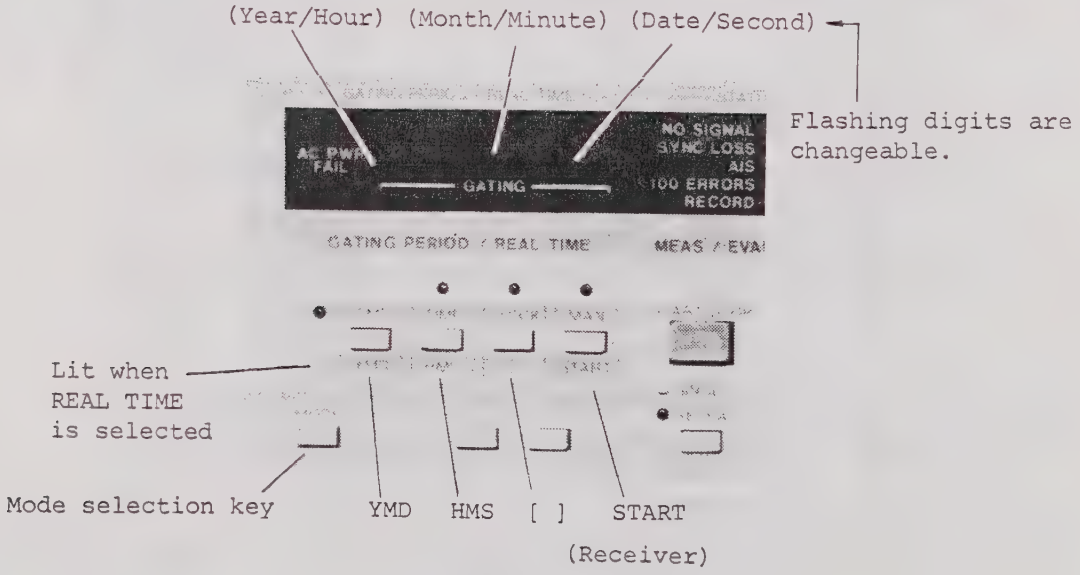


Fig. 6-55 REAL TIME Check

Step	Procedure
1	Select REAL TIME with the [MODE] key.
2	Select the [YMD] (Year, Month, Date)/or [HMS] (Hour, Minute, Second) key. Previously set value of the YMD/HMS is shown. The setting for year, month, and day or for hour, minute, and second are displayed in two digits by numeric LEDs.
3	Select the setting with the shift switch [⟩] if desired. The LED blinks at two dot intervals in year/hour → month/minute → day/—— → none → year/hour ..... , in order, each time the [⟩] key is pressed. The blinking numeric displays can be changed.
4	Set the new real time value step by step with the SET [⩛] or [⩓] key.
5	At the end of real time value re-setting, press the [START] key. The set value is input and new real time display starts from the time when the [START] key is pressed.
6	Confirm that the lamp is continuously lit during setting (from pressing of [⟩] key to pressing of the [START] key), and blinks simultaneously after pressing of the [START] key.

6.5.9 GATING PERIOD setting check

(1) Specifications

Manual gating: START and STOP key

Clock gating: 1 kHz $\leq$ F $\leq$ 1 MHz:
10^6 to 10^{12}, decade steps.

1 MHz $\leq$ F $\leq$ 10 MHz:
10^7 to 10^{12}, decade steps.

10 MHz < F $\leq$ 100 MHz:
10^8 to 10^{12}, decade steps.

100 MHz < F:
10^9 to 10^{12}, decade steps.

Clock gating periods are set by being converted into time in steps of 0.1 seconds.

Single or repetitive

Time gating: 1 sec to 99 days time period, single or repetitive measurement.

1 sec to 1 min in 1-second steps
1 min to 1 hour in 1-minute steps
1 hour to 6 hours in 1/4-hour steps
6 hours to 1 day in 1-hour steps
1 day to 99 days in 1-day steps

Note: Measurement progress is displayed on the 10-segment LED bar display, indicating only elapsed time.

Mode: Single or repeat

(2) Configuration

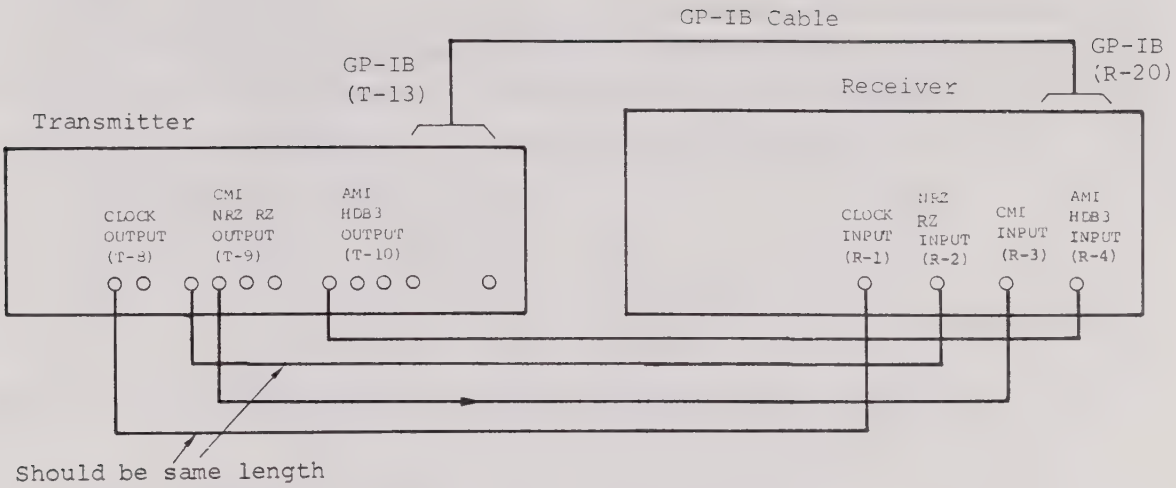


Fig. 6-56 GATING PERIOD Check

(3) Procedure

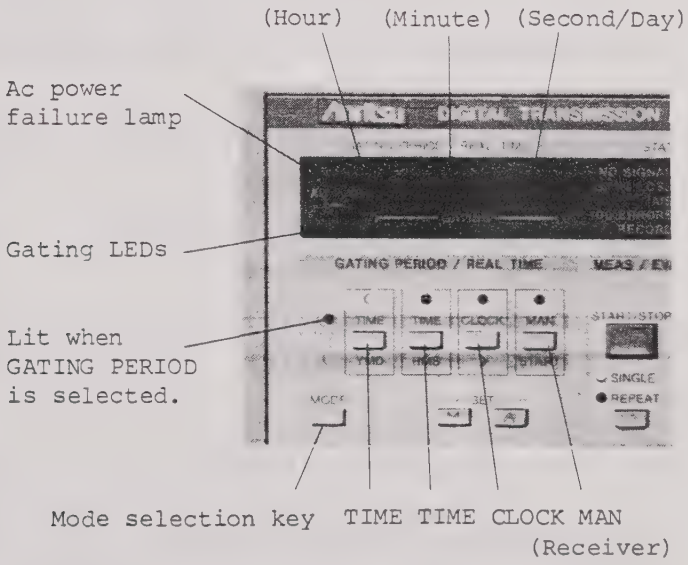


Fig. 6-57 GATING PERIOD Check

Step	Procedure

1 The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient.

Set the references as follows:

(1) Turn off the ME520B(T)/(R) power switch. (T-12, R-17)

(2) Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)

(3) Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)

(4) Turn on the ME520B(T) power switch. (T-12)

(5) Turn on the ME520B(R) power switch. (R-17)

(6) Set the ME520B(T) control switches as shown below.

a)	BIT RATE kb/s (in T-1)	704 (kb/s)
b)	FORMAT (in T-1)	AMI (or HDB3)
c)	PATTERN (in T-2)	PRBS, $[2^{10}-1]$
d)	ZERO SUBSTITUTION (in T-2)	[OFF] (0 position)
e)	ERROR ADDITION	
	MODE (in T-3)	BIT
	RATE (in T-3)	OFF
f)	CLOCK	
	POLARITY (in T-4)	CLOCK
	LEVEL (in T-4)	ECL
g)	AMI HDB3 LEVEL (in T-4)	2.37 V
h)	FREQ OFFSET/JITTER MOD (in T-5)	OFF

(cont.)

Step	Procedure

(7) Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.

a)	INPUT Mode (CMI, AMI, HDB3) (in R-7)	TERM
b)	GATING PERIOD Mode (in R-8)	[MAN]
c)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
d)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
e)	JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
f)	JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]

2 Connect the transmitter and receiver as shown in Fig. 6-56.

Time Gating

3 Press the GATING PERIOD [TIME] key. The gate time can be set in time units.

4 Change the setting to one of 00 00 01 to 99 LED display with the SET [⩒] and [⩓] keys. The setting time for [day] or [hour, minute, second] are displayed in two digits each by numeric LEDs.

The setting steps are shown in Table 6-15.

(cont.)

Step	Procedure

5 After setting the gating period, press the MEASURE [START/STOP] key. The elapsed time is indicated by the gating LEDs as follows:

▭	0 to 10% of the setting time
▭▭	10% to 20% of the setting time
▭▭▭	20% to 30% of the setting time
⋮	⋮
▭▭▭▭▭▭▭▭▭	80% to 90% of the setting time
▭▭▭▭▭▭▭▭▭▭	90% to 100% of the setting time

During measurement, the gating period (numeric LED display value) does not change from the set value.

Clock Gating

6 Press the GATING PERIOD [CLOCK] key. The gate time can be set by number of clocks.

7 Change the setting to clock 10^6 (or other setting) with the SET [⩒] and [⩓] keys. The set number of clocks is displayed at numeric LEDs. The settable number of clocks and the display example are shown in Table 6-16.
Confirm that when the number of clocks 10^6 has purposely been set at a measuring frequency of higher than 1 MHz, the following occurs to show missetting:

(example)

(both ends blink)

(cont.)

Step	Procedure
8	After setting the number of clocks, press the MEASURE [START/STOP] key. The state of the elapsed time display LEDs and numeric displays during measurement is the same as that of step 5.
9	Confirm the following clock gating time check (example).
	a) Set transmitter BIT RATE to 139264 with the [BIT RATE kb/s] key, and FORMAT to CMI with the [FORMAT] key.
	b) Set transmitter ERROR ADDITION to 10^{-3} with the [RATE] key.
	c) Press GATING PERIOD [CLOCK] key, and press the SET [⩒] or [⩓] keys to indicate 1E09.
	d) Set the receiver to SINGLE with the MEASURE selection key.
	e) Press the MEASURE [START/STOP] key.
	f) Confirm that the error measurement result indicates 1.00E06 by pressing the [ERROR COUNT] key.
	Error count = (Number of clocks in gate time) x error rate $= 10^{9} \times 10^{-3} = 1 \times 10^{6}$
10	The exponent and mantissa of the clock gating time can be displayed separately. After the measurement is started with the START key when the CLOCK key is pressed again, the mantissa is displayed. If the CLOCK key is pressed yet again, the exponent is displayed. These operations can be repeated.
	When measurement is completed, the exponent cannot be changed to the mantissa (see paragraph 3.2.7).

(cont.)

Step	Procedure
	Confirm the following clock gating time check (example).
a)	Set the transmitter BIT RATE to 139264 with the [BIT RATE kb/s] key, and FORMAT to CMI with the [FORMAT] key.
b)	Set the transmitter ERROR ADDITION to 10^{-4} with the [RATE] key.
c)	Press GATING PERIOD [CLOCK] key, and press the SET [⩒] or [⩓] keys to indicate 1E09.
d)	Set the receiver to SINGLE with the MEASURE selection key.
e)	Press the MEASURE [START/STOP] key.
f)	Press GATING PERIOD [CLOCK] key.
g)	Confirm that the clock gating display indicates 1.00270 ±0.00002.
h)	Confirm that the error measurement result indicates 100270 ±2 by pressing the [ERROR COUNT] key.
	Error count = (Number of clocks in gate time) x error addition rate of the transmitter = $1.00270 \times 10^{9} \times 10^{-4}$ = 100270

(cont.)

Step	Procedure
	Manual Gating
11	Press the GATING PERIOD [MAN] key. The gate time can be controlled manually. When the MEASURE [START/STOP] key is pressed, manual measurement starts.
12	Confirm that five GATING LEDs light and that the elapsed gate time for hour, minute, and second are displayed in two digits each by numeric LEDs. The elapsed time is reset at the start of each measurement.

When the ac power is recovered after it has gone off while the receiver [POWER] switch is in the ON state, the AC PWR FAIL lamp lights.

For LAST DATA: Ac power interruption during preceding measurement

For CURRENT DATA: Ac power interruption during current measurement

When the power is recovered after it has been interrupted, the AC PWR FAIL lamp lights; this lamp is lit during the gating period, and goes off at the new gating period.

13	Confirm that the AC PWR FAIL lamp comes on and goes off in accordance with the diagram shown in Fig. 6-58. When turning the ac power on and off, disconnect the ac power connector while leaving the receiver POWER switch in the ON position.

Table 6-15 Time Gating Steps

Setting Range	Setting Step
1 second to 1 hour	1 second
1 minute to 1 hour	1 minute
1 hour to 6 hours	15 minutes
6 hours to 1 day	1 hour
1 day to 99 days	1 day

Table 6-16 CLOCK Gating Set

Measuring Frequency	Settable Range of Clocks, decade steps	Display Example
1 kHz $\leq$ F $\leq$ 1 MHz	10^6 to 10^{12}	[ ][1][E][0][6][ ]
1 MHz < F $\leq$ 10 MHz	10^7 to 10^{12}	[ ][1][E][0][7][ ]
10 MHz < F $\leq$ 100 MHz	10^8 to 10^{12}	[ ][1][E][0][8][ ]
100 MHz < F	10^9 to 10^{12}	[ ][1][E][1][2][ ]

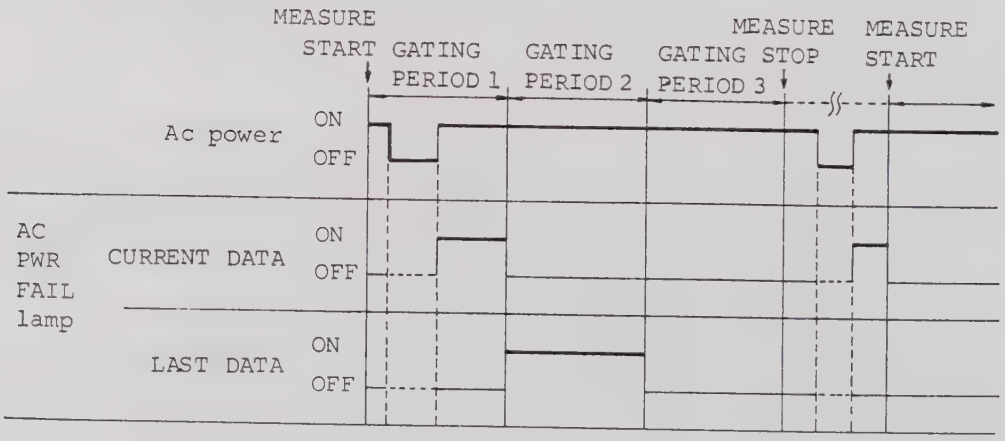


Fig. 6-58 AC PWR FAIL on/off Diagram

6.5.10 SINGLE/REPEAT, LAST DATA/CURRENT DATA setting check

(1) Specification

START/STOP: Controls the start and stop of measurement. Alternates between START and STOP each time the key is pressed.

SINGLE: Only one measurement is performed.

REPEAT: Measurement is performed repeatedly.

LAST DATA: Indicates the measured result(s) of the preceding gating period. The data are updated at the end of each gating period.

CURRENT DATA: Indicates the measured result(s) of the current gating period. The data are updated every 100 ms.

(2) Configuration

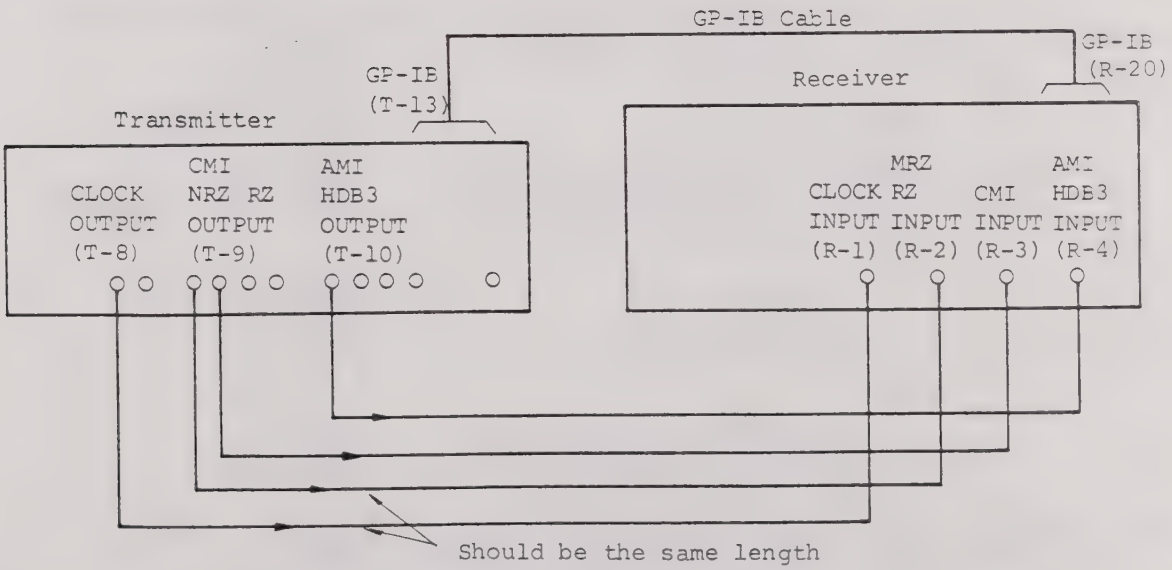


Fig. 6-59 SINGLE/REPEAT, LAST DATA/CURRENT DATA Setting Check

(3) Procedures

Step	Procedure	
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient.	
	Set the references as follows:	
(1)	Turn off the ME520B(T)/(R) power switch. (T-12, R-17)	
(2)	Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)	
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)	
(4)	Turn on the ME520B(T) power switch. (T-12)	
(5)	Turn on the ME520B(R) power switch. (R-17)	
(6)	Set the ME520B(T) control switches as shown below.	
a)	BIT RATE kb/s (in T-1)	704 (kb/s)
b)	FORMAT (in T-1)	AMI (or HDB3)
c)	PATTERN (in T-2)	PRBS, $[2^{10}-1]$
d)	ZERO SUBSTITUTION (in T-2)	[OFF] (0 position)
e)	ERROR ADDITION	
	MODE (in T-3)	BIT
	RATE (in T-3)	OFF
f)	CLOCK	
	POLARITY (in T-4)	CLOCK
	LEVEL (in T-4)	ECL
g)	AMI HDB3 LEVEL (in T-4)	2.37 V
h)	FREQ OFFSET/JITTER MOD (in T-5)	OFF

(cont.)

Step	Procedure

(7) Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.

a)	INPUT Mode (CMI, AMI, HDB3) (in R-7)	TERM
b)	GATING PERIOD Mode (in R-8)	[MAN]
c)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
d)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
e)	JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
f)	JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]

2 Connect the transmitter and receiver as shown in Fig. 6-59.

3 Set receiver GATING PERIOD to 1×10^7 with the [⩔] or [⩓] keys after pressing [MODE], [CLOCK] keys.

Single Measurement

4 Set the receiver to SINGLE with the MEASURE selection key.

5 Press the receiver MEASURE [START/STOP] key.

6 Confirm that measurement ends in about 15 seconds, and that a second measurement is not performed. (To measure again, press the MEASURE [START/STOP] key.)

(cont.)

Step	Procedure
7	Press the MEASURE [START/STOP] key again during step 6 measurement, and check that measurement ends irrespective of elapsed measurement time.
	Repeat Measurement
8	Set the receiver to REPEAT with the MEASURE selection key.
9	Press the receiver MEASURE [START/STOP] key.
10	Confirm that a second measurement starts automatically at the end of the first measurement, in approximately 15 seconds. This operation is repeated until the MEASURE [START/STOP] key is re-pressed.
11	Press the MEASURE [START/STOP] key during the measurement of step 10, and confirm that the repeat measurement is ended.
	Last Data/Current Data Measurement
12	Set the transmitter ERROR ADDITION to SINGLE with the [RATE] key.
13	Set the receiver to LAST DATA with the EVALUATION selection key.
14	Press the receiver MEASURE [START/STOP] key.
15	Press the transmitter ERROR ADDITION [SINGLE] key X_1 times (Error addition X_1) during measurement.

(cont.)

Step	Procedure
16	Confirm that the receiver ERROR display does not change during that measurement (remains 0), but changes (to X_1) at the end of measurement.
17	Set the receiver to CURRENT DATA with the EVALUATION selection key.
18	Press the receiver MEASURE [START/STOP] key.
19	Press the transmitter ERROR ADDITION [SINGLE] key during measurement.
20	Confirm that the receiver ERROR display increases by one each time the transmitter ERROR ADDITION [SINGLE] key is pressed.

6.5.11 STATUS display check

(1) Specifications

No signal:	Indicates loss of signal
Sync loss:	Indicates local pattern reference has lost sync; LED display remains lit for at least 100 ms.
AIS:	Indicates $\leqq$3 zeros in 848 clock periods for 704, 2048, 8448 kb/s and EXT Indicates $\leqq$3 zeros in 1,536 clock periods for 34368 kb/s Indicates $\leqq$4 zeros in 2,928 clock periods for 68736 and 139264 kb/s LED display remains lit for at least 200 ms.
<100 Errors:	Indicates error rate result based on <100 errors
Record:	LED display of this section remains lit for the measuring gating period in which each status occurs

(2) Configuration

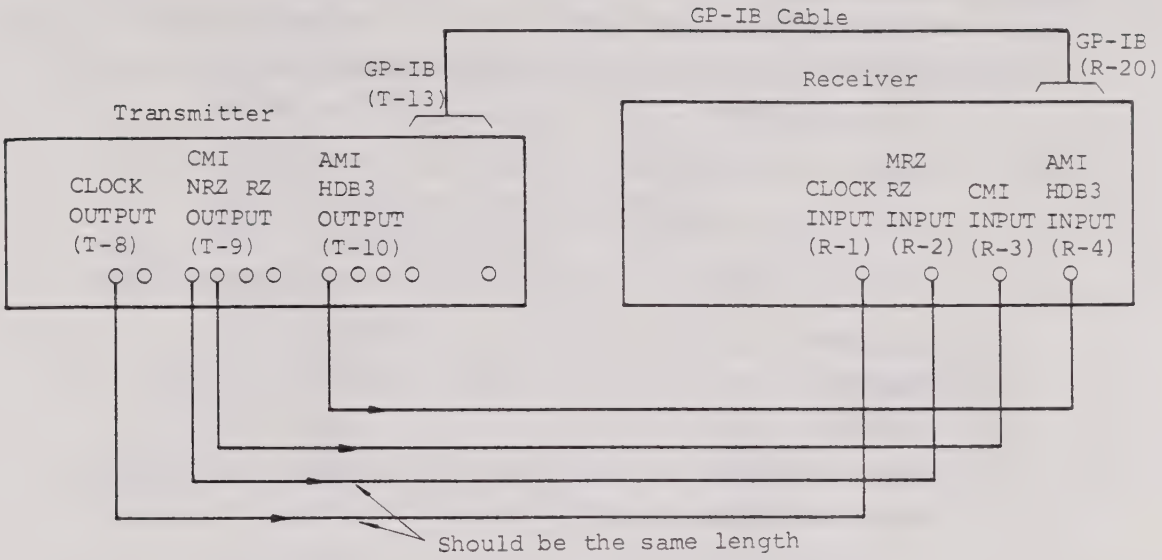


Fig. 6-60 STATUS Display Check

(3) Procedures

Status lamp check (example)

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. Set the references as follows: (1) Turn off the ME520B(T)/(R) power switch. (T-12, R-17) (2) Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)

(cont.)

Step	Procedure	
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)	
(4)	Turn on the ME520B(T) power switch. (T-12)	
(5)	Turn on the ME520B(R) power switch. (R-17)	
(6)	Set the ME520B(T) control switches as shown below.	
a)	BIT RATE kb/s (in T-1)	704 (kb/s)
b)	FORMAT (in T-1)	AMI (or HDB3)
c)	PATTERN (in T-2)	PRBS, [2^{10}-1]
d)	ZERO SUBSTITUTION (in T-2)	[OFF] (0 position)
e)	ERROR ADDITION	
	MODE (in T-3)	BIT
	RATE (in T-3)	OFF
f)	CLOCK	
	POLARITY (in T-4)	CLOCK
	LEVEL (in T-4)	ECL
g)	AMI HDB3 LEVEL (in T-4)	2.37 V
h)	FREQ OFFSET/JITTER MOD (in T-5)	OFF
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
a)	Set the transmitter BIT RATE to 704 (or 2048, 8448, and 34368) with the [BIT RATE kb/s] key, and FORMAT to AMI (or HDB3) with the [FORMAT] key.	
b)	INPUT Mode (CMI, AMI, HDB3) (in R-7)	TERM
c)	GATING PERIOD Mode (in R-8)	[MAN]
d)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA

(cont.)

Step	Procedure	
	e) ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
	f) JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
	g) JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]

2 Connect the transmitter and receiver as shown in Fig. 6-60.

No Signal

3 Disconnect the coaxial cable from the receiver AMI HDB3-INPUT connector and confirm that the NO SIGNAL LED is lit.

4 Confirm that when the cable is reconnected, the NO SIGNAL LED goes off.

5 Set the transmitter BIT RATE kb/s to 68736 (or 139264) with the [BIT RATE] key, and FORMAT to CMI with the [FORMAT] key.

6 Disconnect the coaxial cable from the receiver CMI-INPUT connector and confirm that the NO SIGNAL LED lights.

7 Confirm that when the cable is reconnected, the NO SIGNAL LED goes off.

(cont.)

Step	Procedure
8	Set the transmitter BIT RATE to 139264 (or other setting) with the [BIT RATE] key, and FORMAT to NRZ with the [FORMAT] key.
9	Disconnect the coaxial cable from the receiver CLOCK INPUT connector and check that the NO SIGNAL LED lights.
10	Confirm that when the cable is reconnected, the NO SIGNAL LED goes off.
11	Set the transmitter FORMAT to RZ with the [FORMAT] key.
12	Disconnect the coaxial cable from the receiver NRZ RZ INPUT connector and check that the NO SIGNAL LED lights.
13	Confirm that when the cable is reconnected, the NO SIGNAL LED goes off.
	Sync Loss
14	Press the receiver PATTERN-PRBS [2^{15}-1] key. Confirm that the SYNC LOSS LED lights.
15	Press the receiver PATTERN-PRBS [2^{10}-1] key, and confirm that the SYNC LOSS LED goes off.

(cont.)

Step	Procedure
	AIS
16	Press the transmitter PATTERN-WORD [1-16 BIT] key. And set the word pattern to 1111111111111111 using the [SET 1] key.
17	Confirm that the AIS LED lights.
18	Press the transmitter PATTERN-PRBS [2^{10}-1] key, and confirm that the AIS LED goes off.
	<100 Errors
19	Set the transmitter ERROR ADDITION to SINGLE with the [RATE] key.
20	Press the receiver MEASURE [START/STOP] key, and confirm that the <100 ERRORS LED lights.
21	Press and release the transmitter ERROR ADDITION [SINGLE] key once.
22	While watching the receiver ERROR display, repeat step 21.
23	Check that the <100 ERRORS LED remains lit until the ERROR display indicates 99, and goes off when the ERROR display reaches 100 after pressing the [SINGLE] key.

6.5.12 ERROR MODE, ERROR-DISPLAY MODE check

(1) Specifications

Error mode

BIT error:	For PRBS and WORD Closed loop bit-by-bit detection at binary level
CODE error:	For AMI, HDB3 and CMI codes, code violation detection as follows.
AMI:	Bipolar violations are code errors.
HDB3:	"Violation of violations" rule, i.e., two consecutive bipolar violations with same polarity
CMI:	"Violation of CMI coding rules", i.e., two consecutive bits, whose intervals are one full unit time, with same polarity
BLOCK error:	For PRBS only the block length coincides with the length of the PRBS. Error is detected if a block contains one or more bit errors

(ERROR) RATE key

Method:	Totals errors over selected gating period and automatically scales the result
Gating:	Internal gating, manual gating or external gating are selectable
Display:	0.00E-MN (0.00×10^{-MN})
Range:	MN = 1 to 15 with automatic scaling

Accuracy: Indication given if measurement result is based on <100 errors

(ERROR) COUNT key

Method: Totals errors over selected gating period

Gating: Same as that of ERROR RATE mode

Display: 6-digit LED display with leading zero blanking

Range: When count exceeds 999999, display automatically changes to 0.00E00, with automatic round-up to a maximum count of 9.99E15 (9.99×10^{15})

(ERROR) INTERVALS key

Method: Totals the number of intervals (1, 0.1, 0.01 s) which contain one or more errors. (These intervals can be selected with the rear panel switch.)

Gating: Same as that of ERROR RATE mode

Display: Same as that of ERROR COUNT mode

Range: Same as that of ERROR COUNT mode

(ERROR) Free INTERVALS % key

Method: Totals the number of intervals (1, 0.1, 0.01 s) during which no errors occur over selected gating period

Gating: Same as that of ERROR RATE mode

Display: 6-digit LED display with leading zero blanking up to 100.00%

(2) Configuration

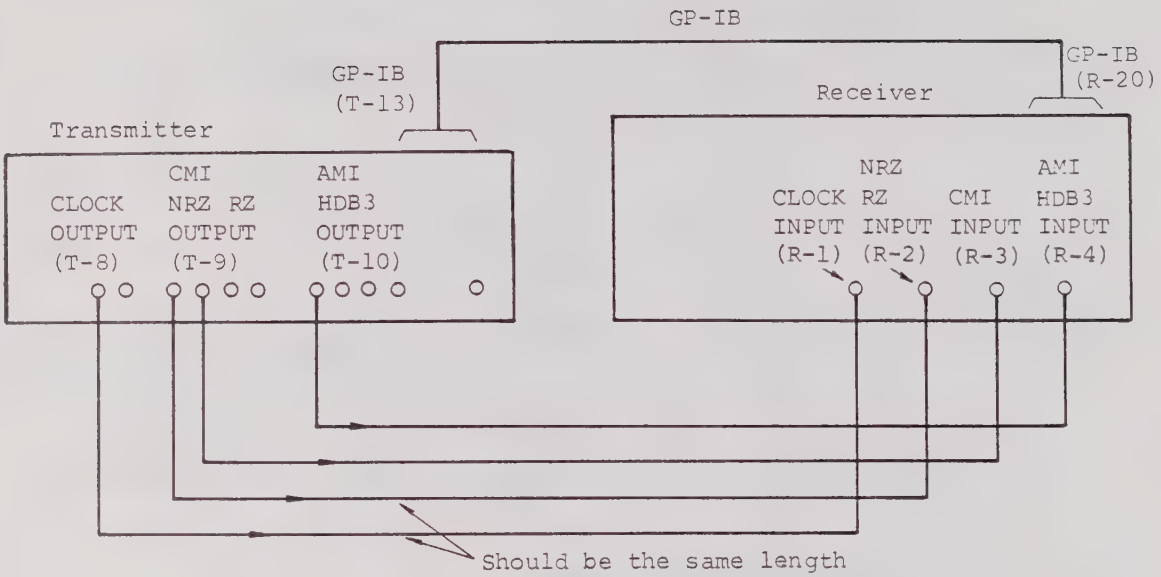


Fig. 6-62 ERROR MODE, ERROR-DISPLAY MODE Check

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B transmitter and receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. The reference settings are shown in Fig. 6-47.
	Set the references as follows:
(1)	Turn off the ME520B(T)/(R) power switch. (T-12, R-17)
(2)	Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)
(4)	Turn on the ME520B(T) power switch. (T-12)
(5)	Turn on the ME520B(R) power switch. (R-17)
(6)	Set the ME520B(T) control switches as shown below.
a)	BIT RATE kb/s (in T-1) — 704 (kb/s)
b)	FORMAT (in T-1) — AMI
c)	PATTERN (in T-2) — PRBS, $[2^{10}-1]$
d)	ZERO SUBSTITUTION (in T-2) — [OFF] (0 position)
e)	ERROR ADDITION
	MODE (in T-3) — BIT
	RATE (in T-3) — OFF
f)	CLOCK
	POLARITY (in T-4) — CLOCK
	LEVEL (in T-4) — ECL

(cont.)

Step	Procedure	
g)	AMI HDB3 LEVEL (in T-4)	2.37 V
h)	FREQ OFFSET/JITTER MOD (in T-5)	OFF
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
a)	INPUT Mode (CMI, AMI, HDB3) (in R-7)	TERM
b)	GATING PERIOD Mode (in R-8)	[CLOCK], 10^7
c)	MEASURE/EVALUATION (in R-11)	SINGLE/CURRENT DATA
d)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
e)	JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
f)	JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-62.	

(cont.)

Step	Procedure
3	Set the receiver ADDITIONAL FUNCTION dip switch (rear panel) as follows. (Error interval changes to 0.01 s)

Switch	Setting:
A	0
B	0
C	0
D	0
E	1
F	1
G	1
H	1

4	Set the transmitter and receiver controls as shown in Table 6-17, and perform self-testing No. 01 to 12.
5	Confirm that the error indications for pressing of the receiver ERROR-DISPLAY MODE [ERROR RATE], [ERROR COUNT], [ERROR INTVLS], and [ERROR FREE INTVLS %] keys conform to those shown in Table 6-18. (Note: The error free intervals display units change alternately from the number of intervals (sum) units → % units → number of intervals (sum) units → ..... each time the receiver ERROR-DISPLAY MODE [ERROR FREE INTVLS %] key is pressed.)

Table 6-17 Self-Testing (Address 0 Mode)

Self-testing No.	To be set for both the Transmitter and Receiver			To be set for the Transmitter					To be set for the Receiver			
				Error Addition		Output		Frequency	Input		Gating	Error
	BIT RATE	FORMAT	PATTERN	MODE	RATE	Clock *1	Data *2	Offset	Clock *3	Data *4	Period	ERROR MODE
01	704 kb	AMI	PRBS $2^{10}-1$ ZERO SUB 0	CODE	10^{-6}	---	2.37 V	OFF	---	TERM	CLOCK 10^{7}	CODE
02	2048 kb	HDB3	PRBS $2^{15}-1$ ZERO SUB 120	CODE	10^{-5}	---	2.37 V	+30 ppm	---	TERM	CLOCK 10^{7}	CODE
03	8448 kb	AMI	PRBS $2^{23}-1$ ZERO SUB 24	CODE	10^{-4}	---	2.37 V	-30 ppm	---	TERM	CLOCK 10^{8}	CODE
04	34368 kb	HDB3	WORD 1-16BIT 1001 0000 0101 0000	CODE	10^{-3}	---	1 V	OFF	---	TERM	CLOCK 10^{9}	CODE
05	68736 kb	CMI	PRBS $2^{15}-1$ ZERO SUB 0	CODE	OFF	---	---	+30 ppm	---	TERM	CLOCK 10^{9}	CODE
06	139264 kb	CMI	PRBS $2^{23}-1$ ZERO SUB 120	CODE	10^{-6}	---	---	-30 ppm	---	TERM	CLOCK 10^{9}	CODE
07	704 kb *5	NRZ	PRBS $2^{23}-1$ ZERO SUB 0	BIT	10^{-6}	CLOCK TTL	ECL	+30 ppm	CLOCK AUTO	ECL	CLOCK 10^{7}	BIT
08	2048 kb *5	RZ	WORD 1-16BIT 1011 001	BIT	10^{-5}	$\overline{\text{CLOCK}}$ ECL	ECL	-30 ppm	$\overline{\text{CLOCK}}$ ECL	ECL	CLOCK 10^{7}	BIT
09	8448 kb *5	NRZ	PRBS $2^{10}-1$ ZERO SUB 64	BIT	10^{-4}	CLOCK ECL	ECL	+30 ppm	CLOCK ECL	ECL	CLOCK 10^{8}	BIT
10	34368 kb *5	RZ	PRBS $2^{15}-1$ ZERO SUB 32	BIT	10^{-6}	CLOCK ECL	ECL	-30 ppm	CLOCK ECL	ECL	CLOCK 10^{9}	BLOCK
11	68736 kb *5	NRZ	PRBS $2^{23}-1$ ZERO SUB 0	BIT	OFF	$\overline{\text{CLOCK}}$ ECL	ECL	+30 ppm	$\overline{\text{CLOCK}}$ ECL	ECL	TIME 1 minute	BIT
12	139264 kb *5	RZ	PRBS $2^{23}-1$ ZERO SUB 120	BIT	10^{-4}	CLOCK ECL	ECL	-30 ppm	CLOCK ECL	ECL	TIME 1 minute	BIT
13 *6	OPTION *5	NRZ	PRBS $2^{23}-1$ ZERO SUB 0	BIT	10^{-3}	CLOCK ECL	ECL	OFF	CLOCK ECL	ECL	TIME 1 minute	BIT

(Note) Other Settings in Receiver are:

. Jitter range	1 UI-PP
. Jitter rate	FAST
. Jitter hit threshold	0.5 UI-PP
. Single/Repeat measurement	SINGLE
. Interval time (rear panel)	0.01 sec
. Jitter (rear panel)	Internal Measuring Signal, Internal Reference Signal

The Transmitter jitter modulation input must not be connected.

ZERO SUB stands for zero substitution.

*1 (Output) Clock: POLARITY/LEVEL

*2 (Output) Data: LEVEL

*3 (Input) Clock: POLARITY/THRESHOLD TERM

*4 (Input) Data: MODE/or THRESHOLD TERM

*5: Set the Receiver to EXT.

*6: Executed only when the frequency option is installed in the Transmitter.

Table 6-18 Error Indication for Self-Testing Results (Typical display in R-12)

Self Test No.	Error Rate	Error Count	Error Intervals	Error Free Intervals		Gating Time Second
				Intervals	%	
01	9.93E-07 / 1.09E-06	10 / 11	10 / 11	1491 / 1420	99.230 / 99.300	14.3
02 *1	9.96E-06 / 1.01E-05	100 / 101	100 / 101	389 / 390	79.387 / 79.591	4.9
03	1.00E-04	10052 / 10053	1190	0	0.000	11.9
04	1.00E-03	1.00E06	2910	0	0.000	29.1
05	0.00E-10	0	0	1460	100.000	14.6
06	9.99E-07 / 1.00E-06	1002 / 1003	720	0	0.000	7.2
07	9.93E-07 / 1.09E-06	10 / 11	10 / 11	1419 / 1420	99.230 / 99.300	14.3
08	9.96E-06 / 1.01E-05	100 / 101	100 / 101	389 / 390	79.387 / 79.591	4.9
09	1.00E-04	10053 / 10054	1190	0	0.000	11.9
10 *2	3.27E-02 / 3.28E-02	1000 / 1001	1000 / 1001	1909 / 1910	65.601 / 65.635	29.1
11	0.00E-10	0	0	6000	100.000	60.0
12	1.00E-04	835559 / 835560	6000	0	0.000	60.0
13	-	-	-	-	-	

Notes: Error Rate, Error Count, Error Intervals, Error Free Intervals, and Error Free Intervals % relationship is shown above.

Note *1 Self-Testing No. 02

With the receiver, the gating period (measure time) is monitored every 0.1 seconds by the internal CPU. That is, the gating period is delimited at each multiple integer of 0.1 seconds.

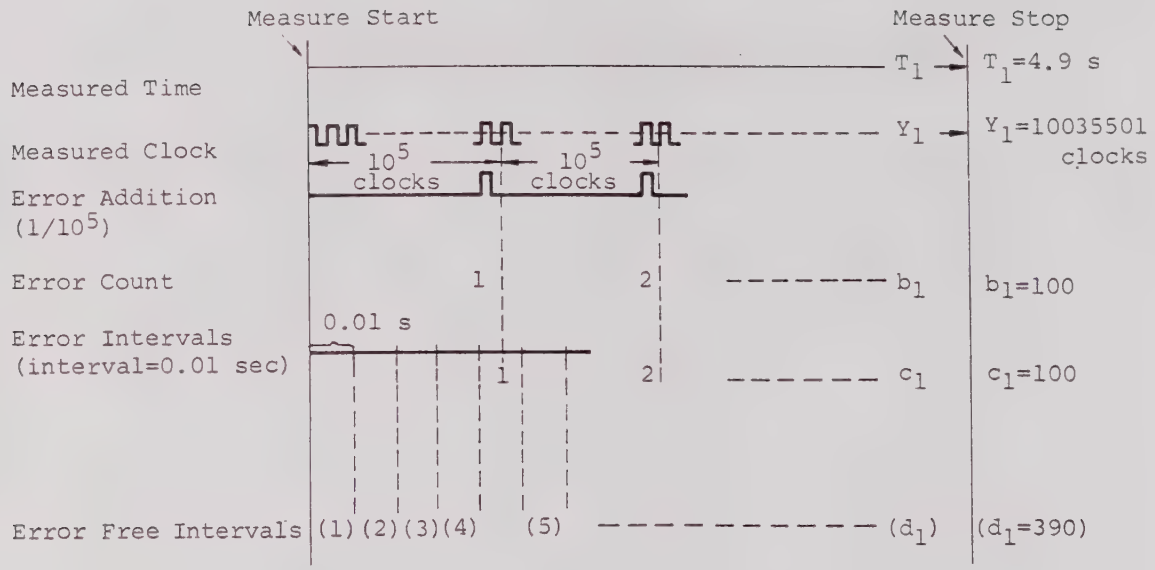


Fig. 6-63 Self-Testing No. 02 Timing Chart (1)

For self test No. 02, the actual gating period (measure time = T_1 seconds) is,

Computed gating period

$$= \frac{10^7 \text{ (gating period set value)}}{2048 \times 10^3 \times (1 + 30 \times 10^{-6}) \text{ (number of clocks in 1 s)}}$$

$$= 4.88 \text{ s}$$

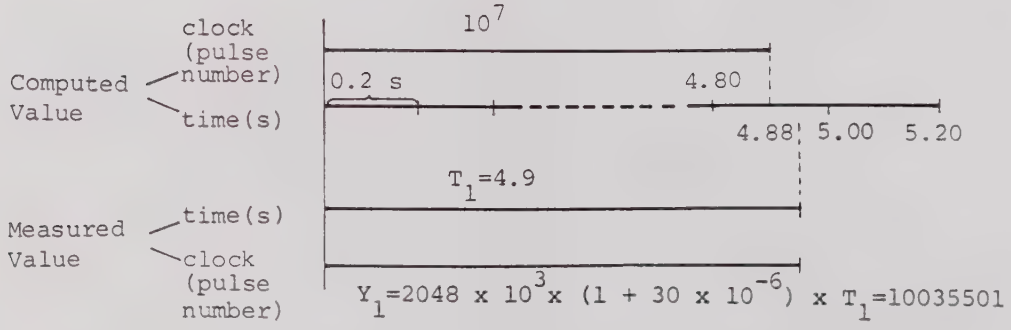


Fig. 6-64 Self-Testing No. 02 Timing Chart (2)

Therefore, error count $(b_1) = Y_1 \times \frac{1}{10^5} = 100.3$

Term b_1 becomes a value of $[100\ ^{+1}_{-0}]$ because of the relationship between the transmitter Error Addition phase and receiver measurement start phase.

The Error Rate is calculated and displayed by the following equation:

$$\text{Error Rate} = \frac{\text{Error Count}}{\text{Total number of clocks in measure time } (Y_1)}$$

$$= \frac{100}{10035501} = 9.96 \times 10^{-6}$$

Next, if $T_1 = 4.9$ seconds, the sum (S_1) of the intervals in the measure time can be computed by the following equation.

$$S_1 = \frac{\text{Measure Time (4.9 s)}}{\text{Time of 1 Interval (0.01 s)}} = 490$$

The receiver measures the error intervals (c_1), computes the value of (d_1) with the following equation.

Error Free Intervals (Intervals) $d_1 = S_1 - C_1 = 390$
Therefore

Error Free Intervals (%)

$$= \frac{\text{Error Free Intervals } (d_1)}{\text{Sum of intervals } (S_1)} \times 100 = 79.591\%$$

Note *2 Self-Testing No. 10

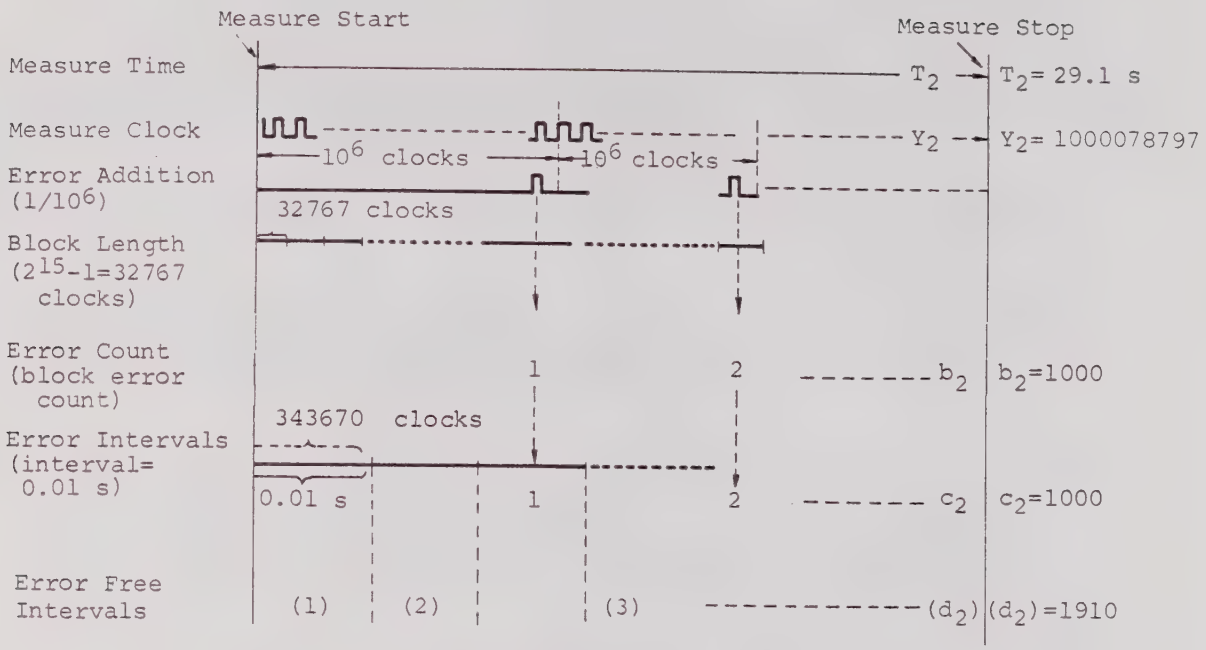


Fig. 6-65 Self-Testing No. 10 Timing Chart

Gating period set value = 10^9 clock

$$\text{Computed gating period} = \frac{10^9}{34368 \times 10^3 \times (1 - 30 \times 10^{-6})}$$

$$= 29.098 \text{ s}$$

Therefore, the actual gating periods T_2, and Y_2 are

$$T_2 = 29.10 \text{ s}$$

$$Y_2 = 34368 \times 10^3 \times (1 - 30 \times 10^{-6}) \times 29.10$$

$$= 1000078797 \text{ clocks}$$

The total number of blocks is

$$B_t = \frac{Y_2}{2^{15}-1} = 30520$$

$$\text{Error Rate} = \frac{\text{Block error count}}{\text{Total number of blocks}} = \frac{b_2}{B_t}$$

$$\cong 3.28 \times 10^{-2}$$

Next, if T_2 = 29.10 seconds, the total number of intervals (S_2) in the measure time is,

$$S_2 = \frac{29.10}{0.01} = 2910$$

Error Free Intervals (Intervals) is,

$$d_2 = S_2 - C_2 = 1910$$

$$\text{Error Free Intervals (\%)} = \frac{d_2}{S_2} \times 100 = 65.635\%$$

6.5.13 ERROR PERFORMANCE check

(1) Specifications

The basic analytical method is the same as CCITT Rec. G.821.

The measurement evaluation period is set by the START/STOP key. This period is the Stotal seconds. For the error performance, during the measurement evaluation period, errors are measured for each one-second interval and the result is evaluated. The error performance parameters normally consist of the unavailable seconds, degraded minutes, severely errored seconds, and errored seconds. In addition, by switching the internal switch, the errored seconds can be converted to error-free seconds. These are all displayed as a percentage. The three items excluding the errored seconds of the error performance parameters can set each corresponding error threshold. Each error threshold can be varied by using the key. The error performance parameters are defined for the following contents.

% Unavailable Seconds (% US):

A period of unavailable time begins when the error rate is worse than threshold 1 for a period of ten consecutive seconds. These ten seconds are considered to be unavailable time. The period of unavailable time terminates when the error rate in each second is better than or equal to threshold 1 for a period of ten consecutive seconds. These ten seconds are considered to be available time.

Sunavail = number of unavailable time

Savail = number of available seconds
= (Stotal - Sunavail)

% US = (Sunavail/Stotal) x 100

threshold 1 = 10^{-2}, 10^{-3}, 10^{-4} selectable

% Severely Errored Seconds (% SES):

Within the Savail period, the total number of 1 second intervals exceeding threshold 2 are considered the severely errored seconds, Ses.

% SES = (Ses/Savail) x 100

threshold 2 = 10^{-2}, 10^{-3}, 10^{-4} selectable

% Degraded Minutes (% DM):

Exclude the Ses from the Savail period and consecutively group the remaining seconds intervals into packets of 60. The total number of packets exceeding threshold 3 are considered the degraded minutes, Md.

% DM = (Md x 60/Savail) x 100

threshold 3 = 10^{-5}, 10^{-6}, 10^{-7} selectable

% Errored Seconds (% ES):

Within the Savail period, the total number of 1 second intervals containing at least a one-count error are considered the errored seconds, Se.

% ES = (Se/Savail) x 100

% Error Free Seconds (% EFS):

% EFS = 100 - % ES

(2) Configuration

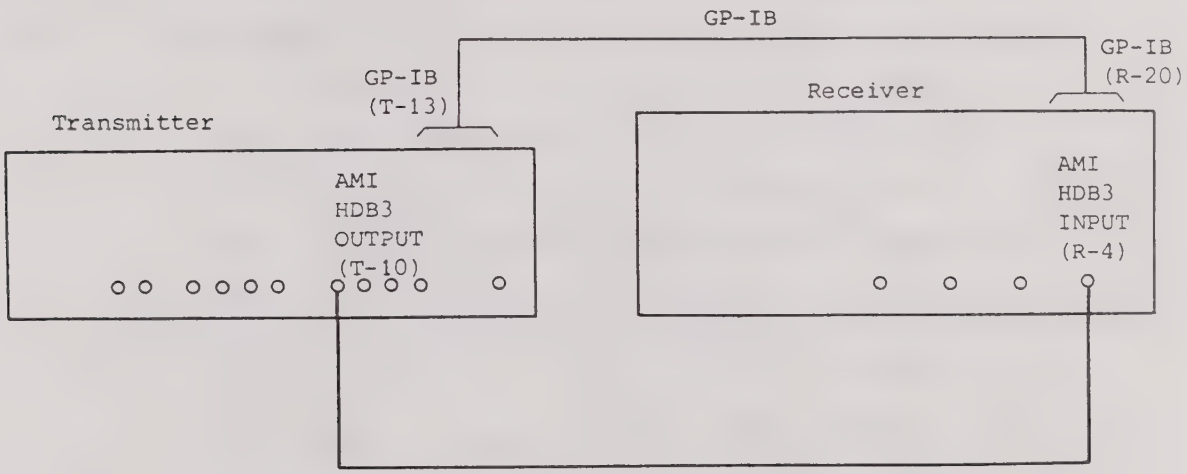


Fig. 6-66 ERROR PERFORMANCE Check

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. The reference settings are shown in Fig. 6-47.
	Set the references as follows:
(1)	Turn off the ME520B(T)/(R) power switch. (T-12, R-17)
(2)	Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)
(4)	Turn on the ME520B(T) power switch. (T-12)
(5)	Turn on the ME520B(R) power switch. (R-17)
(6)	Set the ME520B(T) control switches as shown below.
a)	BIT RATE kb/s (in T-1) — 8448 (kb/s)
b)	FORMAT (in T-1) — HDB3
c)	PATTERN (in T-2) — PRBS, $[2^{15}-1]$
d)	ZERO SUBSTITUTION (in T-2) — [OFF] (0 position)
e)	ERROR ADDITION
	MODE (in T-3) — BIT
	RATE (in T-3) — 10^{-3}
f)	AMI HDB3 LEVEL (in T-4) — 2.37 V
g)	FREQ OFFSET/JITTER MOD (in T-5) — OFF

(cont.)

Step	Procedure

(7) Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.

a) INPUT Mode
(CMI, AMI, HDB3) (in R-7) — TERM

b) GATING PERIOD Mode (in R-8) — [TIME], 2 min.

c) MEASURE/EVALUATION (in R-11) — SINGLE/CURRENT DATA

d) ERROR
DISPLAY MODE (in R-13) — [ERROR COUNT]
SYNC (in R-13) — [AUTO]

e) JITTER
RANGE (UI-PP) (in R-15) — 1
RATE (in R-15) — FAST

f) JITTER
FILTER (in R-15) — OFF
DISPLAY MODE (in R-15) — [JITTER (UI)]

2 Connect the transmitter and receiver as shown in Fig. 6-66.

3 Set the receiver PRINTER OUTPUT SELECTION and ADDITIONAL FUNCTION dip switches (rear panel) as follows:

PRINTER OUTPUT SELECTION

Switch	Setting:
A	0
B	0
C	0
D	0
E	0
F	0
G	0
H	1

ADDITIONAL FUNCTION

Switch	Setting:
A	0
B	0
C	0
D	0
E	1
F	1
G	1
H	1

(cont.)

Step	Procedure
4	Press the receiver ERROR DISPLAY MODE [SHIFT] key.
5	Press the receiver ERROR DISPLAY MODE [%US] key.
6	Press the receiver ERROR THRESHOLD [SET] key twice.
7	Set the receiver ERROR THRESHOLD to 5×10^{-4} with the [⩔] or [⩓] keys.
8	Press the receiver ERROR DISPLAY MODE [%SES] key.
9	Repeat steps 6 and 7.
10	Press the receiver ERROR DISPLAY MODE [%DM] key, and press the ERROR THRESHOLD [SET] key twice.
11	Set the receiver ERROR THRESHOLD to 5×10^{-6} with the [⩔] or [⩓] keys.
12	Press the receiver PRINTER [PRINT] key.
13	Press the receiver MEAS [START/STOP] key.
14	Confirm that the measurement results of the error performance are as follows:

ER	1.00E-03
%US	100.0000
%SES	0.0000
%DM	0.0000
%ES	0.0000
%EFS	0.0000

(cont.)

Step	Procedure
15	Repeat steps 5 and 6.
16	Set the receiver ERROR THRESHOLD to 5 x 10^{-3} with the [⩒] or [⩓] keys.
17	Press the receiver MEAS [START/STOP] key.
18	Confirm that the measurement results of the error performance are as follows: ER 1.00E-03 %US 0.0000 %SES 100.0000 %DM 0.0000 %ES 100.0000 %EFS 0.0000
19	Set the transmitter ERROR ADDITION to 10^{-5} with the [RATE] key.
20	Press the receiver MEAS [START/STOP] key.
21	Confirm that the measurement results of the error performance are as follows: ER 1.00E-05 %US 0.0000 %SES 0.0000 %DM 100.0000 %ES 100.0000 %EFS 0.0000
22	Set the transmitter ERROR ADDITION to OFF with the [RATE] key.

(cont.)

Step	Procedure
23	Press the receiver MEAS [START/STOP] key.
24	Confirm that the measurement results of the error performance are as follows: ER 0.00E-10 %US 0.0000 %SES 0.0000 %DM 0.0000 %ES 0.0000 %EFS 100.0000

6.5.14 JITTER-DISPLAY MODE, HIT THRESHOLD check

(1) Specifications

Peak-to-peak jitter

Range 1 UI: 0.000 to 1.010 UI-PP
10 UI: 0.00 to 10.10 UI-PP

In DATA input, measured jitter amplitudes and frequencies meet CCITT Recommendation O.171. Table 3. (See Fig. 6-67 and Table 6-19.)

The nominal measurement ranges for the CLOCK input are expanded up to bracket area ("ME520B CLOCK") in Fig. 6-67.

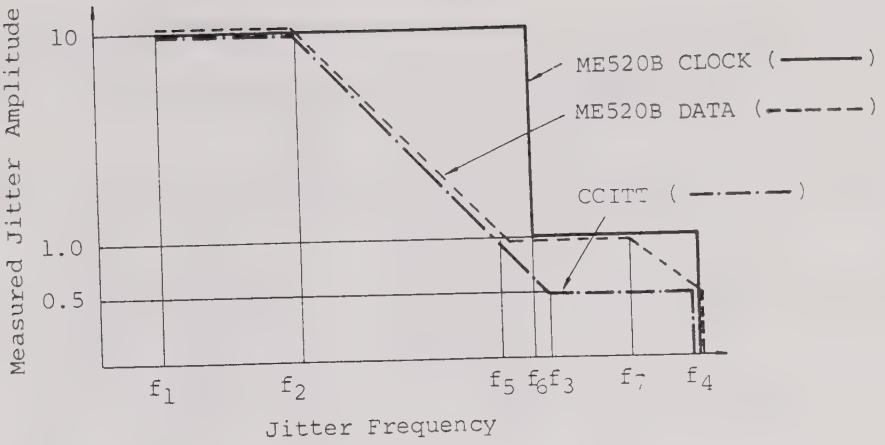


Fig. 6-67 Jitter Amplitude of Measured CLOCK/DATA

Table 6-19 CCITT REC. O.171

Bit Rate (kb/s)	CCITT REC. O.171				ME520B (typical)		
	f_1 (Hz)	f_2 (Hz)	f_3 (Hz)	f_4 (Hz)	f_5 (Hz)	f_6 (Hz)	f_7 (Hz)
704	(20)	(1 k)	-	(35 k)	7 k	8 k	10 k
2048	20	2.4 k	45 k	100 k	24 k	27 k	30 k
8448	20	10.7 k	200 k	400 k	107 k	110 k	120 k
34368	100	1 k	20 k	800 k	10 k	344 k	320 k
68736	(100)	(40 k)	-	(1 M)	400 k	400 k	500 k
139264	200	500	10 k	3.5 M	100 k	500 k	1.4 M

Lower frequency limit: 20 Hz (range 1)
5 Hz (range 10)

Note: Using the EXT JITTER REF CLOCK (rear panel) and the slowest display rate, the lower frequency limit of the measurement bandwidth can be reduced to 0.1 Hz.

Display Rate: Selectable FAST, MED, or SLOW rate

FAST: Valid for measurements of jitter frequency >10 Hz

MED: Valid for measurements of jitter frequency >1 Hz

SLOW: Valid for measurements of jitter frequency >0.1 Hz (external jitter reference clock only)

Accuracy: ±4% ± additional error as shown below (with HP1, LP)

Table 6-20 Additional Error

Range	Additional Error in UI-PP				
	Data HDB3	Data CMI	Clock $F \leq 50$ MHz	Clock 50 MHz$< F \leq$150 MHz	Clock F>150 MHz (OPT 02)
Range 1	$\leq$0.035	$\leq$0.08	$\leq$0.01	$\leq$0.02	$\leq$0.03
Range 10	$\leq$0.12	$\leq$0.24	$\leq$0.1	$\leq$0.2	$\leq$0.3

Positive peak/negative peak jitter

Range: 1/2 specified range of the peak-to-peak jitter

Accuracy: With no filtering in the measurement path

Range 1: ±5% ±0.1 additional error (as in peak-to-peak)

Range 10: ±5% ±0.1 additional error (as in peak-to-peak)

Other specifications are the same as the peak-to-peak jitter measurement.

(2) Configuration

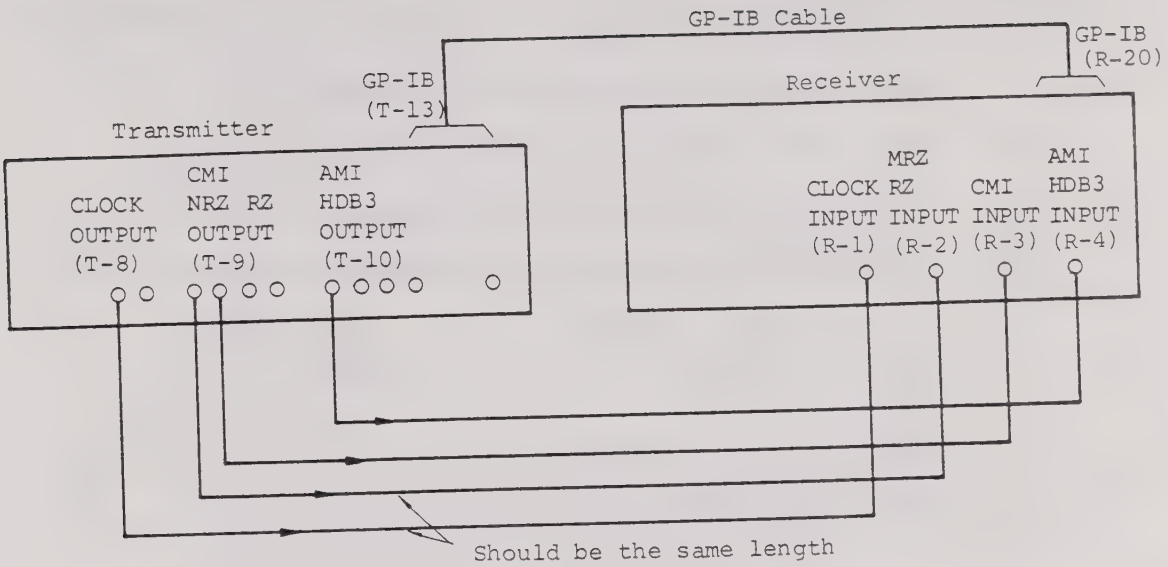


Fig. 6-68 JITTER DISPLAY MODE, HIT THRESHOLD Check

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. Set the references as follows: (1) Turn off the ME520B(T)/(R) power switch. (T-12, R-17) (2) Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)

(cont.)

Step	Procedure	
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)	
(4)	Turn on the ME520B(T) power switch. (T-12)	
(5)	Turn on the ME520B(R) power switch. (R-17)	
(6)	Set the ME520B(T) control switches as shown below.	
a)	BIT RATE kb/s (in T-1)	704 (kb/s)
b)	FORMAT (in T-1)	AMI
c)	PATTERN (in T-2)	PRBS, $[2^{10}-1]$
d)	ZERO SUBSTITUTION (in T-2)	[OFF] (0 position)
e)	ERROR ADDITION	
	MODE (in T-3)	BIT
	RATE (in T-3)	OFF
f)	CLOCK	
	POLARITY (in T-4)	CLOCK
	LEVEL (in T-4)	ECL
g)	AMI HDB3 LEVEL (in T-4)	2.37 V
h)	FREQ OFFSET/JITTER MOD (in T-5)	OFF
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
a)	INPUT Mode (CMI, AMI, HDB3) (in R-7)	TERM
b)	GATING PERIOD Mode (in R-8)	[MAN]
c)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
d)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]

(cont.)

Step	Procedure	
	e) JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
	f) JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]

2 Connect the transmitter and receiver as shown in Fig. 6-68.

3 Set the receiver ADDITIONAL FUNCTION dip switch (rear panel) as follows. (Error interval, Jitter hit interval changes to 0.01 s.)

Switch	Setting:
A	0
B	0
C	0
D	0
E	1
F	1
G	1
H	0

(cont.)

Step	Procedure
4	Set the transmitter and receiver switches as shown in Table 6-17 and perform self-testing No. 01 to 12.
5	Confirm that the jitter indications on pressing the receiver JITTER-DISPLAY MODE [JITTER UI], [HIT COUNT], [HIT INTVLS], and [HIT FREE INTVLS %] keys conform to those shown in Table 6-21. Note: The Hit Free Intervals display units change alternately from the number of intervals (sum) units → % units → number or intervals (sum) units → ..... each time the receiver JITTER-DISPLAY MODE [HIT FREE INTVLS %] key is pressed.
6	Check that the Jitter data display blinks in the following cases: a) When measurements are made with the internal reference clock, the jitter display blinks for the PLL pull-in time, and dc cut circuit time constant (approximately 8 s). b) When measurements are made with the external reference clock, the jitter display blinks for the dc cut circuit time constant (approximately 15 s).

(cont.)

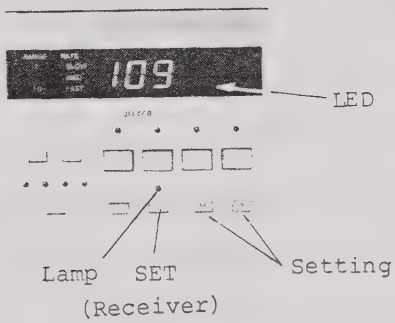
Step	Procedure

c) When measured result overflows

RANGE 10: 10.11 P-P or more,
+5.09 or more, -5.09 or less

RANGE 1: 1.011 P-P or more,
+0.509 or more, -0.509 or less

Setting Hit Threshold



7 Check that when the [SET] key is pressed, the lamp lights and the threshold value is shown on the LEDs display.

8 Set the HIT THRESHOLD value with the [⩒] and [⩓] keys. The threshold is set by adjusting the RANGE.

RANGE	Threshold (UI)	Step (UI)
1	0.050 to 0.500	0.001
10	0.50 to 5.00	0.01

(cont.)

Step	Procedure
9	When the [HIT COUNT] key is pressed, the lamp goes off and the receiver returns to DISPLAY MODE from Hit THRESHOLD setting mode. For range and threshold relationships other than the above, the SET lamp blinks.
	Display mode - Jitter UI, print
10	Press the receiver JITTER-DISPLAY MODE [JITTER UI] key.
11	Check that the jitter of the input clock or code data are measured and three types of data (PP, +P, and -P) are displayed on the JITTER LEDs each time the [JITTER UI] key is pressed.
12	Check that in the CURRENT DATA mode, the current jitter is measured and displayed on the JITTER LEDs in accordance with RATE of SLOW, MED, or FAST with the [RATE] key.
13	Check that in the LAST DATA mode, the maximum value of the gating period set by the MEASURE [START/STOP] key for GATING PERIOD and MEASURE or EVALUATION is displayed on the JITTER LEDs. In jitter measurement, a reference clock and the unknown clock must be input. The reference clock is one of the six internal frequencies (704, 2048, 8448, 34369, 68736, 139264 kHz). The external clock is input from the JITTER REF CLOCK-OUTPUT connector on the rear panel.

(cont.)

Step	Procedure
14	Press the JITTER-DISPLAY MODE [JITTER UI]-[PRINT] key to print the Jitter UI mode value with the optional printer.
15	Check that when this key is pressed, the displayed jitter contents and the time are printed by the printer (option 01).

Table 6-21 JITTER Indication for Self-Testing Results (Typical display in R-14)

Self-Testing No.	Jitter UI	Hit Count	Hit Intervals	Hit Free Intervals	
				Intervals	%
01	0.004	0	0	1430	100.000
02	0.005	0	0	490	100.000
03	0.014	0	0	1190	100.000
04	0.011	0	0	2910	100.000
05	0.065	0	0	1460	100.000
06	0.045	0	0	720	100.000
07	0.004	0	0	1430	100.000
08	0.004	0	0	490	100.000
09	0.005	0	0	1190	100.000
10	0.006	0	0	2910	100.000
11	0.004	0	0	6000	100.000
12	0.010	0	0	6000	100.000
13	-	-	-		

6.5.15 JITTER DEMOD-OUTPUT check

(1) Specifications

Impedance: Nominal voltage source

Amplitude:

Range 1: 1.0 V/UI-PP

Range 10: 0.1 V/UI-PP

Dc content: Typically $\leqq$5 mV

(2) Configuration

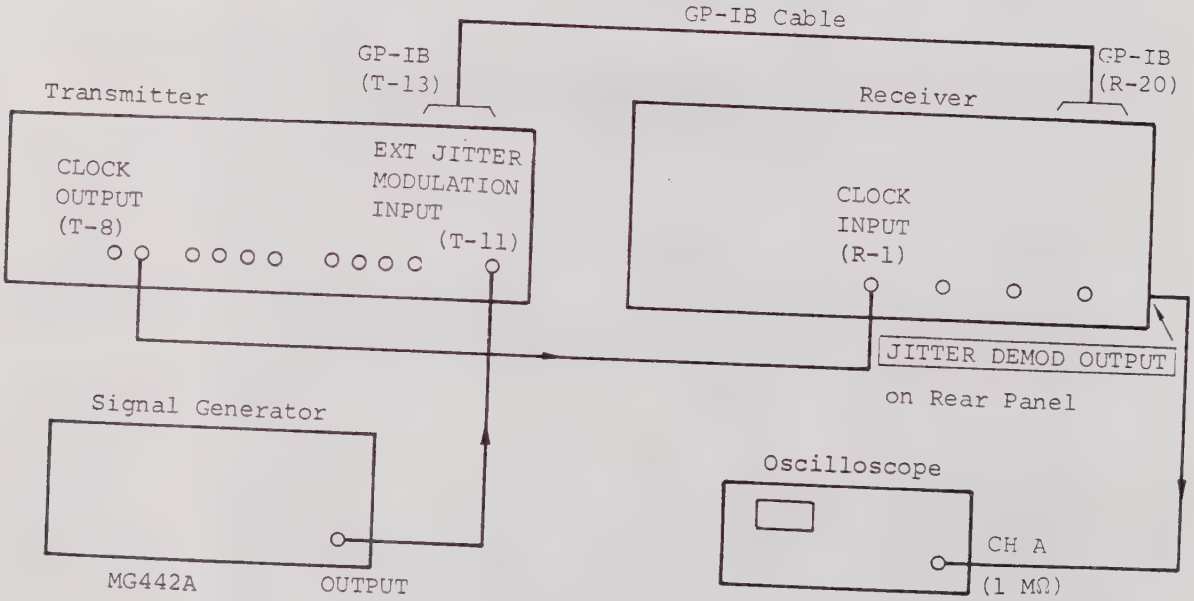


Fig. 6-69 JITTER DEMOD-OUTPUT Check

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. Set the references as follows: (1) Turn off the ME520B(T)/(R) power switch. (T-12, R-17) (2) Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20) (3) Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21) (4) Turn on the ME520B(T) power switch. (T-12) (5) Turn on the ME520B(R) power switch. (R-17) (6) Set the ME520B(T) control switches as shown below. a) BIT RATE kb/s (in T-1) — 34368 (kb/s) b) FORMAT (in T-1) — NRZ c) PATTERN (in T-2) — PRBS, $[2^{10}-1]$ d) ZERO SUBSTITUTION (in T-2) — [OFF] (0 position) e) ERROR ADDITION MODE (in T-3) — BIT RATE (in T-3) — OFF f) CLOCK POLARITY (in T-4) — CLOCK LEVEL (in T-4) — ECL

(cont.)

Step	Procedure	
	g) NRZ RZ LEVEL (in T-4)	ECL
	h) FREQ OFFSET/JITTER MOD (in T-5) (Set FREQ OFFSET to 0 ppm, then set to JITTER MODULATION.)	JITTER MODULATION
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
	a) GATING PERIOD Mode (in R-8)	[MAN]
	b) MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
	c) ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
	d) JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
	e) JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-69.	
3	Set the signal generator frequency to 1 kHz. Then adjust the Signal Generator output so that the transmitter JITTER MOD display is 0.50 UI-PP.	
4	Check that the oscilloscope display corresponds to the waveform shown in Fig. 6-70.	

V: 0.2 V/div H: 0.5 ms/div

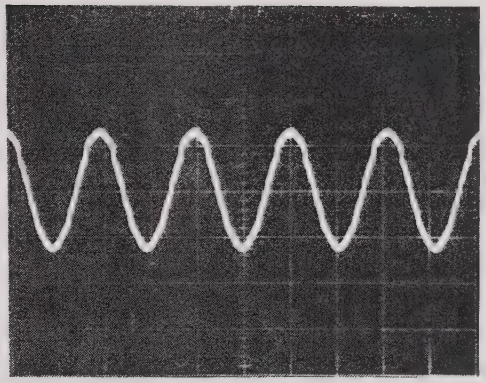


Fig. 6-70 JITTER DEMOD-OUTPUT Waveform

6.5.16 JITTER REF CLOCK-OUT check

The connector is used when the receiver ADDITIONAL FUNCTION dip switch (rear panel) F is set to INT.

When the F switch is set to 1, internal reference ECL output is selected. When the F switch is set to 0, external reference clock ECL input is selected.

The output is the ECL gate IC output, terminated into 130 Ω (G)/180 Ω (-5.2 V).

(1) Specifications

Function:	Provides an output of the derived reference clock when using the internal reference.
Selection:	Set ADDITIONAL FUNCTION switch F to 1.
Impedance:	Nominal 75 Ω unbalanced to -2 V
Amplitude:	Nominal ECL level

(2) Configuration

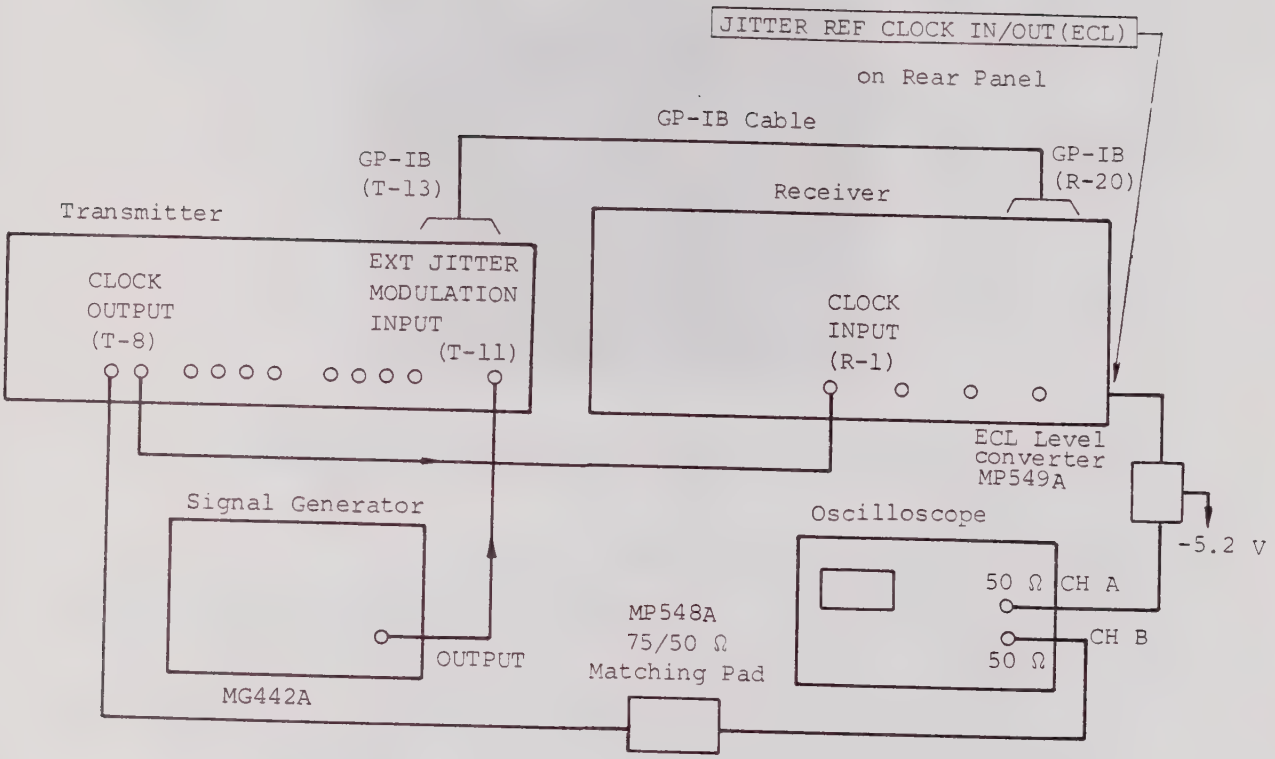


Fig. 6-71 JITTER REF CLOCK-OUT Check

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. Set the references as follows: (1) Turn off the ME520B(T)/(R) power switch. (T-12, R-17) (2) Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20) (3) Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21) (4) Turn on the ME520B(T) power switch. (T-12) (5) Turn on the ME520B(R) power switch. (R-17) (6) Set the ME520B(T) control switches as shown below. a) BIT RATE kb/s (in T-1) — 34368 (kb/s) b) FORMAT (in T-1) — NRZ c) PATTERN (in T-2) — PRBS, $[2^{10}-1]$ d) ZERO SUBSTITUTION (in T-2) — [OFF] (0 position) e) ERROR ADDITION MODE (in T-3) — BIT RATE (in T-3) — OFF f) CLOCK POLARITY (in T-4) — CLOCK LEVEL (in T-4) — ECL

(cont.)

Step	Procedure	
g)	NRZ RZ LEVEL (in T-4)	ECL
h)	FREQ OFFSET/JITTER MOD (in T-5) (Set FREQ OFFSET ot 0 ppm, then set to JITTER MODULATION.)	JITTER MODULATION
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
a)	GATING PERIOD Mode (in R-8)	[MAN]
b)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
c)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
d)	JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
e)	JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-71.	
3	Set the signal generator frequency to 1 kHz. Then adjust the Signal Generator output so that the transmitter JITTER MOD display is 0.50 UI-PP.	
4	Check that the oscilloscope display corresponds to the waveform shown in Fig. 6-72.	

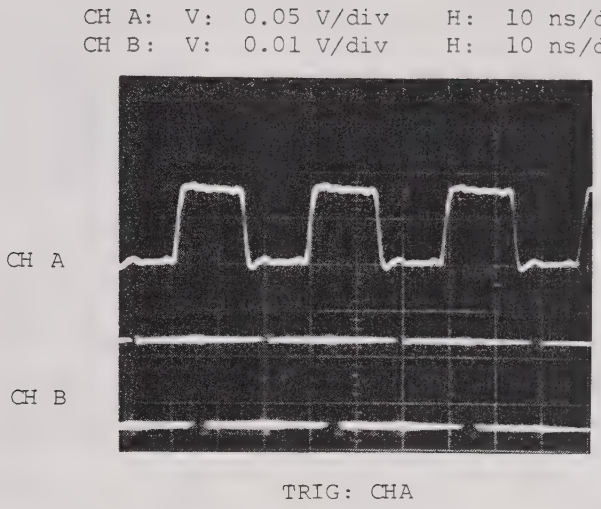


Fig. 6-72 JITTER REF CLOCK-OUT Waveform

6.5.17 JITTER REF CLOCK-IN check

The connector is used when the receiver ADDITIONAL FUNCTION dip switch (rear panel) F is set to EXT.

When the F switch is set to 1, internal reference ECL signal is selected. When the F switch is set to 0, external reference clock ECL input signal is selected.

The input is the ECL gate IC input, terminated into 130 Ω (G)/180 Ω (-5.2 V).

(1) Specifications

Function:	Serves as the input for an external reference clock.
Selection:	Set ADDITIONAL FUNCTION switch F to 0.
Impedance:	Nominal 75 Ω unbalanced to -2 V
Amplitude:	Nominal ECL level

(2) Configuration

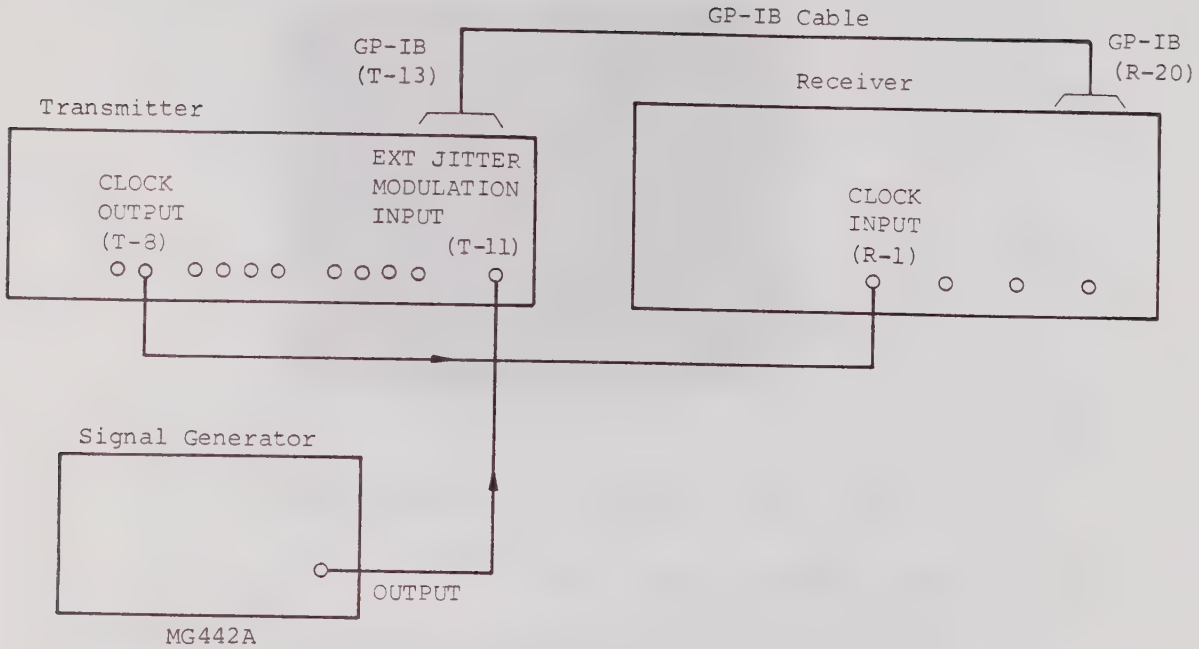


Fig. 6-73 JITTER REF CLOCK-IN Check

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. Set the references as follows: (1) Turn off the ME520B(T)/(R) power switch. (T-12, R-17) (2) Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)

(cont.)

Step	Procedure	
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)	
(4)	Turn on the ME520B(T) power switch. (T-12)	
(5)	Turn on the ME520B(R) power switch. (R-17)	
(6)	Set the ME520B(T) control switches as shown below.	
a)	BIT RATE kb/s (in T-1)	34368 (kb/s)
b)	FORMAT (in T-1)	NRZ
c)	PATTERN (in T-2)	PRBS, $[2^{10}-1]$
d)	ZERO SUBSTITUTION (in T-2)	[OFF] (0 position)
e)	ERROR ADDITION	
	MODE (in T-3)	BIT
	RATE (in T-3)	OFF
f)	CLOCK	
	POLARITY (in T-4)	CLOCK
	LEVEL (in T-4)	ECL
g)	NRZ RZ LEVEL (in T-4)	ECL
h)	FREQ OFFSET/JITTER MOD (in T-5) (Set FREQ OFFSET to 0 ppm, then set to JITTER MODULATION.)	JITTER MODULATION
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
a)	GATING PERIOD Mode (in R-8)	[MAN]
b)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
c)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]

(cont.)

Step	Procedure	
	d) JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
	e) JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-73.	
3	Set the signal generator frequency to 1 kHz. Then adjust the signal generator output so that the transmitter JITTER MOD display is 0.50 UI-PP.	
4	Remember the receiver JITTER UI-PP display value for future reference.	
5	Set the receiver ADDITIONAL FUNCTION dip switch (rear panel) F switch to 0 side.	
6	Connect the transmitter JITTER REF CLOCK-OUTPUT (ECL) connector (rear panel) and the receiver JITTER REF CLOCK-IN/OUT (ECL) connector (rear panel) with a 75 Ω coaxial cable.	
7	Check that the receiver JITTER UI-PP value is about equal to the value measured in step 4.	

6.5.18 JITTER MEASURE-INPUT check

This connector is used when the ADDITIONAL FUNCTION dip switch (rear panel) G switch is set to 0. Jitter display corresponding to the analog voltage input applied to this input connector is then performed. The input sensitivity value is 1.0 V/UI-PP for RANGE 1 and 0.1 V/UI-PP for RANGE 10.

When evaluating jitter with a filter other than the built-in filter, insert an external filter between the receiver JITTER MEASURE-INPUT connector (rear panel) and the receiver JITTER DEMOD-OUTPUT connector (rear panel).

(1) Specifications

Selection: Selected by rear panel switch (R-23).

Impedance: Nominal 2.5 kΩ

(2) Configuration

Same as that of paragraph 6.5.17 (Fig. 6-73).

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. Set the references as follows: (1) Turn off the ME520B(T)/(R) power switch. (T-12, R-17) (2) Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)

(cont.)

Step	Procedure	
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)	
(4)	Turn on the ME520B(T) power switch. (T-12)	
(5)	Turn on the ME520B(R) power switch. (R-17)	
(6)	Set the ME520B(T) control switches as shown below.	
a)	BIT RATE kb/s (in T-1)	34368 (kb/s)
b)	FORMAT (in T-1)	NRZ
c)	PATTERN (in T-2)	PRBS, [2^{10}-1]
d)	ZERO SUBSTITUTION (in T-2)	[OFF] (0 position)
e)	ERROR ADDITION	
	MODE (in T-3)	BIT
	RATE (in T-3)	OFF
f)	CLOCK	
	POLARITY (in T-4)	CLOCK
	LEVEL (in T-4)	ECL
g)	NRZ RZ LEVEL (in T-4)	ECL
h)	FREQ OFFSET/JITTER MOD (in T-5) (Set FREQ OFFSET to 0 ppm, then set to JITTER MODULATION.)	JITTER MODULATION
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
a)	GATING PERIOD Mode (in R-8)	[MAN]
b)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
c)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]

(cont.)

Step	Procedure	
	d) JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
	e) JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-73.	
3	Set the signal generator frequency to 1 kHz. Then adjust the signal generator output so that the transmitter JITTER MOD display is 0.50 UI-PP.	
4	Remember the receiver JITTER UI-PP displayed value for future reference.	
5	Set the receiver ADDITIONAL FUNCTION dip switch (rear panel) G switch to 0.	
6	Connect the receiver JITTER DEMOD-OUTPUT connector (rear panel) and JITTER MEASURE-INPUT connector (rear panel) with 75 Ω coaxial cable.	
7	Check whether the receiver JITTER UI-PP value is about equal to the value measured in step 4.	

6.5.19 CLOCK MONITOR-OUTPUT check

(1) Specifications

Source: Recovered clock from AMI, HDB3 and CMI data inputs or front panel clock input

Amplitude: Nominal ECL level

(2) Configuration

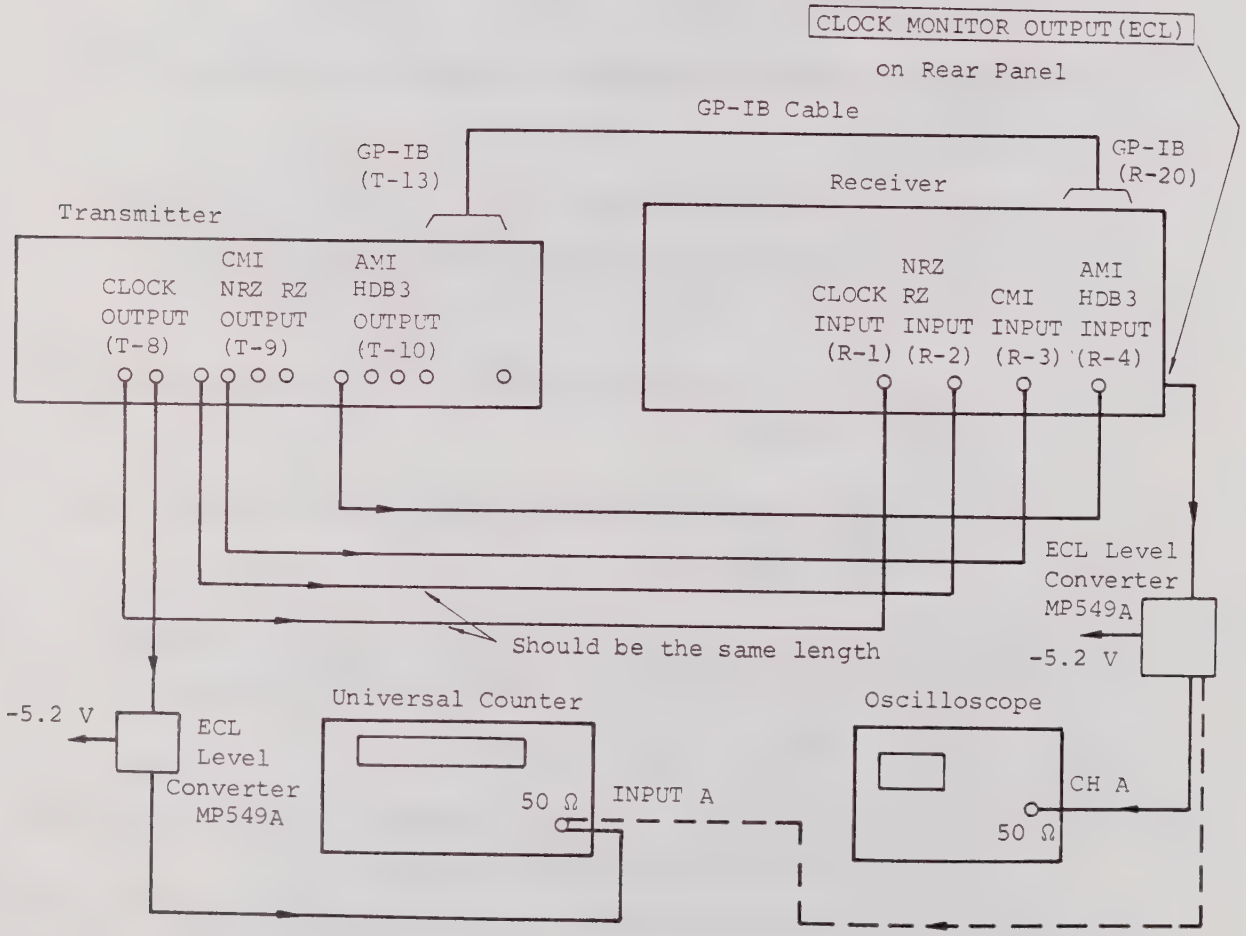


Fig. 6-74 CLOCK MONITOR-OUTPUT Check

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. Set the references as follows: (1) Turn off the ME520B(T)/(R) power switch. (T-12, R-17) (2) Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20) (3) Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21) (5) Turn on the ME520B(T) power switch. (T-12) (4) Turn on the ME520B(R) power switch. (R-17) (6) Set the ME520B(T) control switches as shown below. a) BIT RATE kb/s (in T-1) — 704 (kb/s) b) FORMAT (in T-1) — NRZ c) PATTERN (in T-2) — PRBS, $[2^{10}-1]$ d) ZERO SUBSTITUTION (in T-2) — [OFF] (0 position) e) ERROR ADDITION MODE (in T-3) — BIT RATE (in T-3) — OFF f) CLOCK POLARITY (in T-4) — CLOCK LEVEL (in T-4) — ECL

(cont.)

Step	Procedure	
	g) NRZ RZ LEVEL (in T-4)	ECL
	h) FREQ OFFSET/JITTER MOD (in T-5)	OFF
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
	a) GATING PERIOD Mode (in R-8)	[MAN]
	b) MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
	c) ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
	d) JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
	e) JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-74.	
3	Set the transmitter FORMAT to AMI (or HDB3) with the [FORMAT] key, and BIT RATE to 704 (or 2048, 8448, 34368) with the [BIT RATE kb/s] key.	
4	Set the receiver INPUT CMI/AMI HDB3 mode to TERM with the [MODE] key.	

(cont.)

Step	Procedure
5	Measure the frequency of the transmitter CLOCK-OUTPUT connector signal with a frequency counter. Similarly measure the frequency of the receiver CLOCK MONITOR-OUTPUT connector (rear panel) signal with a Frequency Counter.
6	Check that the two measured values are the same.
7	Set the transmitter FORMAT to CMI with the [FORMAT] key, and BIT RATE to 68736 (or 139264) with the [BIT RATE kb/s] key.
8	Repeat steps 5 and 6.
9	Set the transmitter FORMAT to NRZ (or RZ) with the [FORMAT] key, and BIT RATE to 704 (or 2048, 8448, 34368, 68736, 139264) with the [BIT RATE kb/s] key.
10	Repeat steps 5 and 6.
11	An example of the CLOCK MONITOR-OUTPUT waveform is shown in Fig. 6-75

V: 0.05 V/div H: 0.05 µs/div

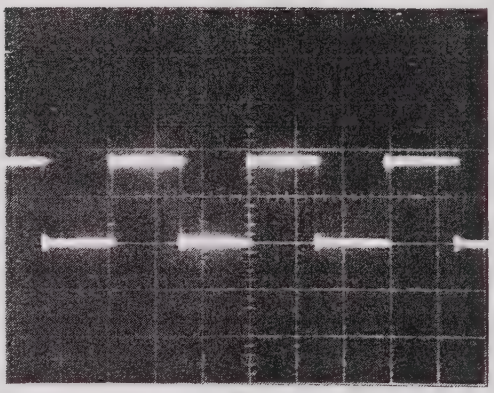


Fig. 6-75 CLOCK MONITOR-OUTPUT Waveform (AMI, 704 kb/s)

6.5.20 DATA-OUTPUT/PATTERN SYNC-OUTPUT check

(1) Specifications

DATA-OUTPUT (rear panel)

Source:	Decoded AMI, HDB3, CMI, NRZ and RZ input data
Format:	Binary NRZ
Impedance:	Nominal low, unbalanced
Amplitude:	Nominal ECL level

PATTERN SYNC OUTPUT (rear panel)

Format:	PRBS: one pulse/sequence, 2- to 16-bit word length: one pulse/two sequences, 1-bit word length: one pulse/4 bits
Width:	Two clock periods (except with zero substitution when width stretched to approxmately that of zero block)
Amplitude:	Nominal ECL level

(2) Configuration

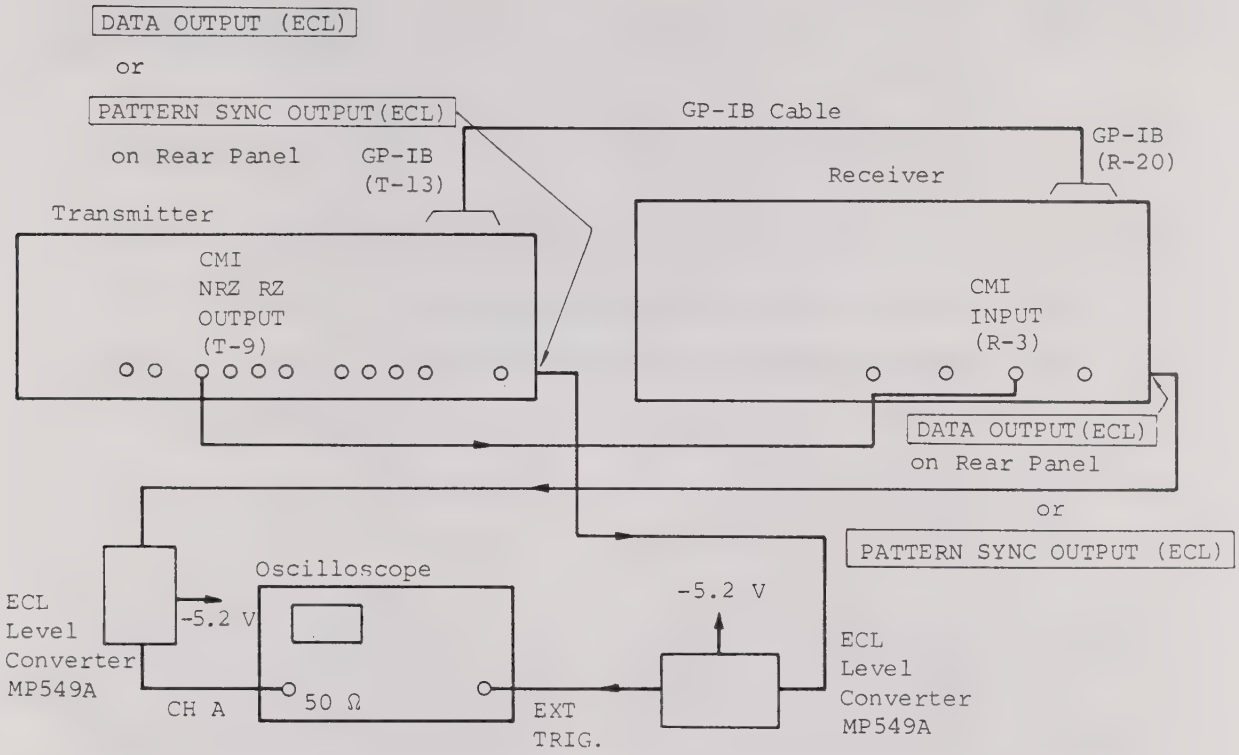


Fig. 6-76 DATA-OUTPUT/PATTERN SYNC OUTPUT Check

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. Set the references as follows: (1) Turn off the ME520B(T)/(R) power switch. (T-12, R-17)

(cont.)

Step	Procedure	
(2)	Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)	
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)	
(4)	Turn on the ME520B(T) power switch. (T-12)	
(5)	Turn on the ME520B(R) power switch. (R-17)	
(6)	Set the ME520B(T) control switches as shown below.	
a)	BIT RATE kb/s (in T-1)	139264 (kb/s)
b)	FORMAT (in T-1)	CMI
c)	PATTERN (in T-2)	WORD, 1-16 BIT
d)	ERROR ADDITION	
	MODE (in T-3)	BIT
	RATE (in T-3)	OFF
e)	FREQ OFFSET/JITTER MOD (in T-5)	OFF
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
a)	INPUT Mode (CMI, AMI, HDB3) (in R-7)	TERM
b)	GATING PERIOD Mode (in R-8)	[MAN]
c)	MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
d)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
e)	JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST

(cont.)

Step	Procedure
	f) JITTER FILTER (in R-15) OFF DISPLAY MODE (in R-15) [JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-76.
3	Set word pattern to 100100 using the [SET 1] and [SET 0] keys.
4	Confirm that the oscilloscope display corresponds to the waveform shown in Fig. 6-77.
5	Disconnect the coaxial cable from the receiver DATA-OUTPUT connector (rear panel), and connect it to PATTERN SYNC-OUTPUT connector (rear panel).
6	Press the PATTERN PRBS [2^{10}-1] (or [2^{15}-1], [2^{23}-1]) key.
7	Confirm that the oscilloscope display corresponds to the waveform shown in Fig. 6-78.

V: 0.05 V/div H: 10 ns/div

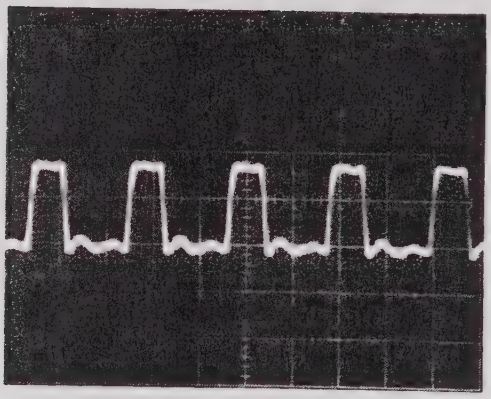
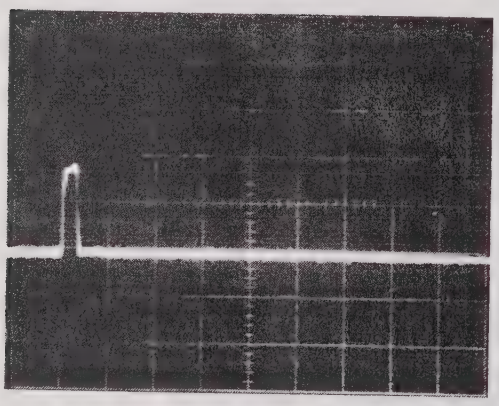


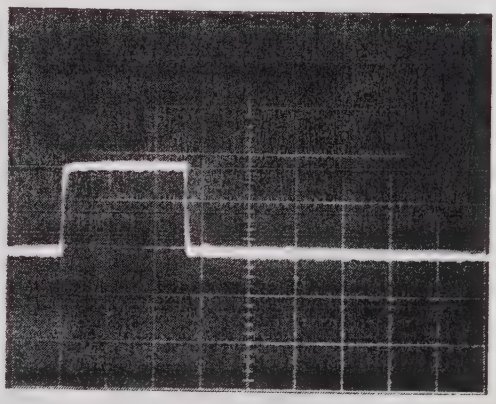
Fig. 6-77 DATA-OUTPUT Waveform

V: 0.05 V/div H: 50 ns/div



(a) Zero Sub.= 0

V: 0.05 V/div H: 50 ns/div



(b) Zero Sub.= 16

Fig. 6-78 PATTERN SYNC-OUTPUT Waveform

6.5.21 ERROR-OUTPUT check

(1) Specifications

Format: One pulse per error

Amplitude: Nominal ECL level

(2) Configuration

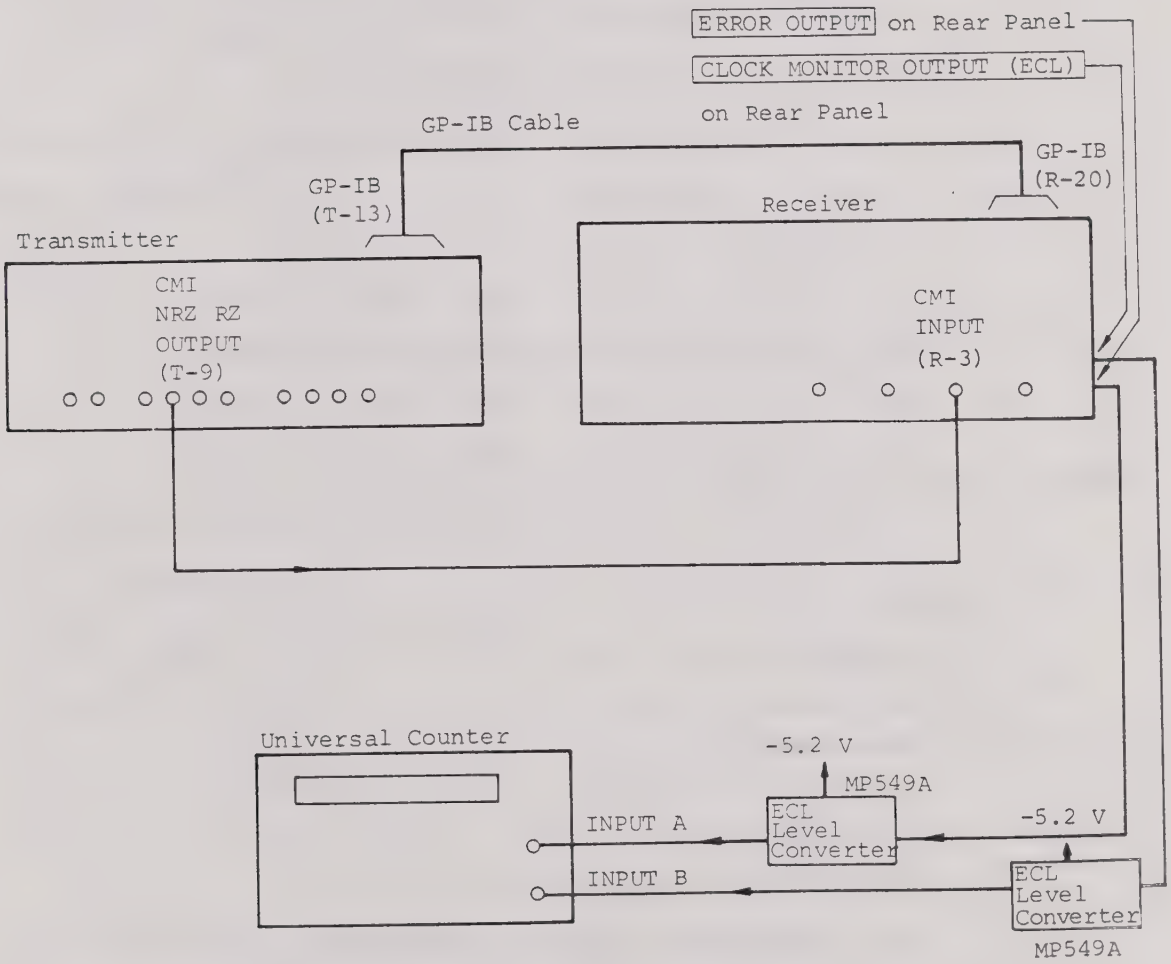


Fig. 6-79 ERROR-OUTPUT CHECK

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient.
	Set the references as follows:
(1)	Turn off the ME520B(T)/(R) power switch. (T-12, R-17)
(2)	Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)
(4)	Turn on the ME520B(T) power switch. (T-12)
(5)	Turn on the ME520B(R) power switch. (R-17)
(6)	Set the ME520B(T) control switches as shown below.
a)	BIT RATE kb/s (in T-1) — 139264 (kb/s)
b)	FORMAT (in T-1) — CMI
c)	PATTERN (in T-2) — PRBS, $[2^{23}-1]$
d)	ZERO SUBSTITUTION (in T-2) — [OFF] (0 position)
e)	ERROR ADDITION
	MODE (in T-3) — BIT
	RATE (in T-3) — OFF
f)	FREQ OFFSET/JITTER MOD (in T-5) — OFF
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.
a)	INPUT Mode (CMI, AMI, HDB3) (in R-7) — TERM

(cont.)

Step	Procedure	
	b) GATING PERIOD Mode (in R-8)	[MAN]
	c) MEASURE/EVALUATION (in R-11)	REPEAT/CURRENT DATA
	d) ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
	e) JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
	f) JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-79.	
3	Set the universal counter to measure RATIO B/A and the frequency resolution switch to 1 (1 MHz).	
4	Change the transmitter ERROR ADDITION through 10^{-6}, 10^{-5}, 10^{-4}, and 10^{-3} with the [RATE] key.	
5	Confirm that the universal counter display corresponds to the value shown in Table 6-22.	

Table 6-22 ERROR-OUTPUT Check

ERROR ADDITION Rate Setting	Counter Display
10^{-6}	1000000 (±1 count)
10^{-5}	100000 (±1 count)
10^{-4}	10000 (±1 count)
10^{-3}	1000 (±1 count)

6.5.22 NO SIGNAL (status) OUTPUT check

(1) Specification

Source: Same as status display

Amplitude: Nominal TTL level

(2) Configuration

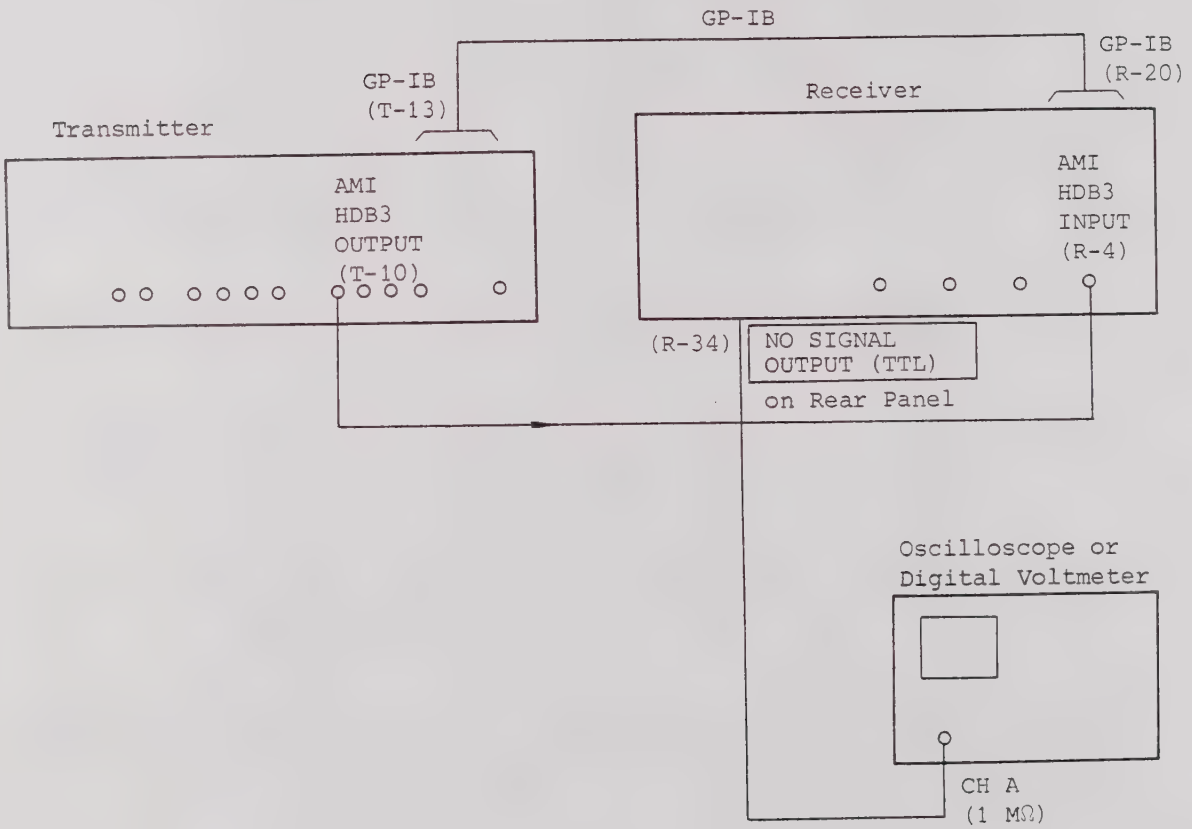


Fig. 6-80 NO SIGNAL (Status) OUTPUT Check

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. The reference settings are shown in Fig. 6-47. Set the references as follows: (1) Turn off the ME520B(T)/(R) power switch. (T-12, R-17) (2) Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20) (3) Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21) (4) Turn on the ME520B(T) power switch. (T-12) (5) Turn on the ME520B(R) power switch. (R-17) (6) Set the ME520B(T) control switches as shown below. a) BIT RATE kb/s (in T-1) 8448 (kb/s) b) FORMAT (in T-1) HDB3 c) PATTERN (in T-2) PRBS, $[2^{15}-1]$ d) ZERO SUBSTITUTION (in T-2) [OFF] (0 position) e) ERROR ADDITION MODE (in T-3) BIT RATE (in T-3) OFF f) AMI HDB3 LEVEL (in T-4) 2.37 V g) FREQ OFFSET/JITTER MOD (in T-5) OFF

(cont.)

Step	Procedure	
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
	a) INPUT Mode (CMI, AMI, HDB3) (in R-7)	TERM
	b) GATING PERIOD Mode (in R-8)	[MAN]
	c) MEASURE/EVALUATION (in R-11)	SINGLE/CURRENT DATA
	d) ERROR	
	DISPLAY MODE (in R-13)	[ERROR COUNT]
	SYNC (in R-13)	[AUTO]
	e) JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST
	f) JITTER	
	FILTER (in R-15)	OFF
	DISPLAY MODE (in R-15)	[JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-80.	
3	Confirm that the NO SIGNAL OUTPUT level is TTL low (< +0.5 V).	
4	Disconnect the coaxial cable from the AMI HDB3 INPUT connector.	
5	Confirm that the NO SIGNAL OUTPUT level is TTL high (> +3.0 V).	

6.5.23 SYNC LOSS (Status) OUTPUT check

(1) Specification

Source: Same as status display

Amplitude: Nominal TTL level

(2) Configuration

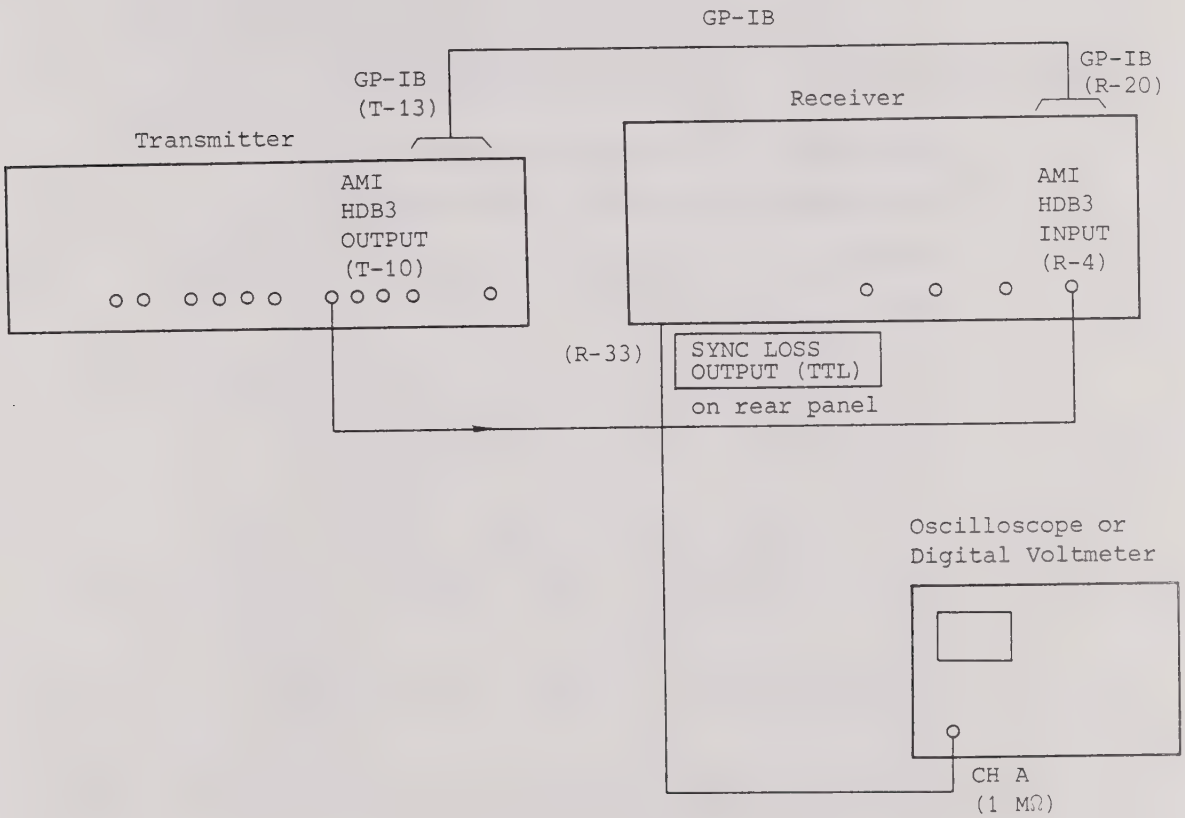


Fig. 6-81 SYNC LOSS (status) OUTPUT Check

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. The reference settings are shown in Fig. 6-47.
	Set the references as follows:
(1)	Turn off the ME520B(T)/(R) power switch. (T-12, R-17)
(2)	Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)
(4)	Turn on the ME520B(T) power switch. (T-12)
(5)	Turn on the ME520B(R) power switch. (R-17)
(6)	Set the ME520B(T) control switches as shown below.
a)	BIT RATE kb/s (in T-1) — 2048 (kb/s)
b)	FORMAT (in T-1) — HDB3
c)	PATTERN (in T-2) — PRBS, $[2^{15}-1]$
d)	ZERO SUBSTITUTION (in T-2) — [OFF] (0 position)
e)	ERROR ADDITION
	MODE (in T-3) — BIT
	RATE (in T-3) — OFF
f)	AMI HDB3 LEVEL (in T-4) — 2.37 V
g)	FREQ OFFSET/JITTER MOD (in T-5) — OFF

(cont.)

Step	Procedure
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.
	a) INPUT Mode (CMI, AMI, HDB3) (in R-7) — TERM
	b) GATING PERIOD Mode (in R-8) — [MAN]
	c) MEASURE/EVALUATION (in R-11) — SINGLE/CURRENT DATA
	d) ERROR
	DISPLAY MODE (in R-13) — [ERROR COUNT]
	SYNC (in R-13) — [AUTO]
	e) JITTER
	RANGE (UI-PP) (in R-15) — 1
	RATE (in R-15) — FAST
	f) JITTER
	FILTER (in R-15) — OFF
	DISPLAY MODE (in R-15) — [JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-81.
3	Confirm that the SYNC LOSS OUTPUT level is TTL low (<0.5 V).
4	Press the receiver PATTERN-PRBS [2^{23}-1] key.
5	Confirm that the SYNC LOSS OUTPUT level is TTL high (>3.0 V).

6.5.24 ERROR RATE OUTPUT check

(1) Specification

Generates dc voltages proportional to the exponent of measured error rate ranging from 10^{-15} to 10^{-2}. The voltage changes in 0.5 V steps, and is made up to date at each end of gating periods.

The relationship between error rate, status signal and output voltage is as follows:

Table 6-23 ERROR RATE OUTPUT Voltage

Status or ER	X ±0.2 V	ER or EC	X ±0.2 V
NO SIGNAL	10.0	$10^{-8} \leq ER < 10^{-7}$	5.0
SYNC LOSS	9.5	$10^{-9} \leq ER < 10^{-8}$	4.5
AIS	9.0	$10^{-10} \leq ER < 10^{-9}$	4.0
———	——	$10^{-11} \leq ER < 10^{-10}$	3.5
$10^{-2} \leq ER$	8.0	$10^{-12} \leq ER < 10^{-11}$	3.0
$10^{-3} \leq ER < 10^{-2}$	7.5	$10^{-13} \leq ER < 10^{-12}$	2.5
$10^{-4} \leq ER < 10^{-3}$	7.0	$10^{-14} \leq ER < 10^{-13}$	2.0
$10^{-5} \leq ER < 10^{-4}$	6.5	$10^{-15} \leq ER < 10^{-14}$	1.5
$10^{-6} \leq ER < 10^{-5}$	6.0	$ER < 10^{-15}$	1.0
$10^{-7} \leq ER < 10^{-6}$	5.5	———	——
		EC = 0	0.0

(X: +ve output voltage
ER: Error Rate
EC: Error Count)

Note:

Error rate checking ($10^{-15} \leq ER < 10^{-14}$ and $ER < 10^{-15}$) is omitted since it requires a very long time.

(2) Configuration

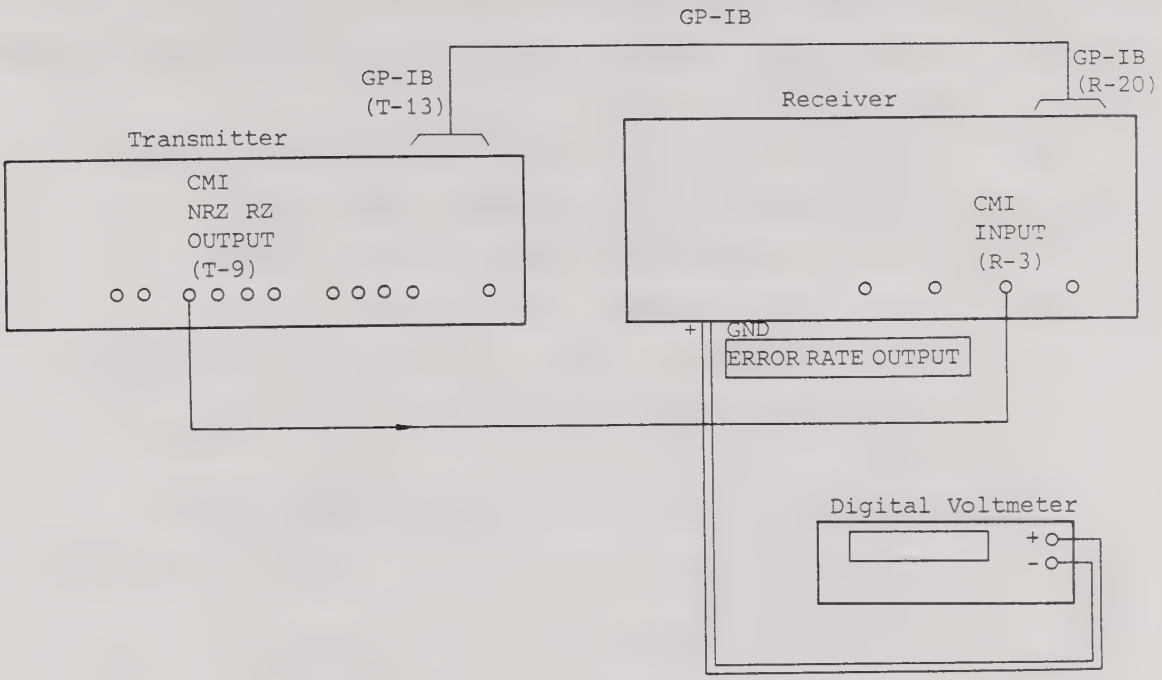


Fig. 6-82 ERROR RATE OUTPUT Check

(3) Procedures

Step	Procedure
1	The ME520B(R) performance checks are performed in combination with ME520B(T). The ME520B Transmitter and Receiver have many control keys with the same settings and automatically controlling the receiver from the transmitter through a GP-IB cable is convenient. The reference settings are shown in Fig. 6-47. Set the references as follows:
(1)	Turn off the ME520B(T)/(R) power switch. (T-12, R-17)

(cont.)

Step	Procedure	
(2)	Connect the ME520B(T)/(R) with the GP-IB cable. (Rear panel) (T-13, R-20)	
(3)	Set the ME520B(T)/(R) rear panel DIP switch to all "OFF" as shown in Fig. 6-47. (T-14, R-21)	
(4)	Turn on the ME520B(T) power switch. (T-12)	
(5)	Turn on the ME520B(R) power switch. (R-17)	
(6)	Set the ME520B(T) control switches as shown below.	
a)	BIT RATE kb/s (in T-1)	139264 (kb/s)
b)	FORMAT (in T-1)	CMI
c)	PATTERN (in T-2)	PRBS, $[2^{23}-1]$
d)	ZERO SUBSTITUTION (in T-2)	[OFF] (0 position)
e)	ERROR ADDITION	
	MODE (in T-3)	BIT
	RATE (in T-3)	OFF
f)	FREQ OFFSET/JITTER MOD (in T-5)	OFF
(7)	Set the ME520B(R) control switches as shown below. However, do not operate the switches whose settings are linked with the transmitter settings.	
a)	INPUT Mode (CMI, AMI, HDB3) (in R-7)	TERM
b)	GATING PERIOD Mode (in R-8)	[MAN]
c)	MEASURE/EVALUATION (in R-11)	SINGLE/CURRENT DATA
d)	ERROR	
	DISPLAY MODE (in R-13)	[ERROR RATE]
	SYNC (in R-13)	[AUTO]
e)	JITTER	
	RANGE (UI-PP) (in R-15)	1
	RATE (in R-15)	FAST

(cont.)

Step	Procedure
	f) JITTER FILTER (in R-15) OFF DISPLAY MODE (in R-15) [JITTER (UI)]
2	Connect the transmitter and receiver as shown in Fig. 6-82.
	NO SIGNAL
3	Press the receiver MEAS [START/STOP] key.
4	Disconnect the coaxial cable from the receiver CMI INPUT connector.
5	Reconnect the coaxial cable to the receiver CMI INPUT connector.
6	Press the receiver MEAS [START/STOP] key.
7	Confirm that the ERROR RATE OUTPUT voltage equal to 10.0 ±0.2 V.
	SYNC LOSS
8	Press the receiver PATTERN-PRBS [2^{15}-1] key.
9	Press the receiver MEAS [START/STOP] key.
10	Repeat step 9.
11	Confirm that the ERROR RATE OUTPUT voltage equal to 9.5 ±0.2 V.

(cont.)

Step	Procedure
	AIS
12	Set the transmitter PATTERN-WORD [1-16 BIT] key. And set the word pattern to 111 using the [CLEAR] and [SET 1] keys.
13	Press the receiver MEAS [START/STOP] key twice.
14	Confirm that the ERROR RATE OUTPUT voltage equal to 9.0 ±0.2 V.
	$10^{-2} \leq$ ER
15	Set the transmitter PATTERN-PRBS [2^{23}-1] key.
16	Set the receiver control switches as shown below.
	a) GATING PERIOD Mode (in R-8) TIME, 1 s
	b) ERROR-SYNC (in R-13) MAN
	c) PATTERN-PRBS (in R-6) 2^{15}-1
	(After step b), next step c).)
17	Press the receiver MEAS [START/STOP] key.
18	Confirm that the ERROR RATE OUTPUT voltage equal to 8.0 ±0.2 V.

(cont.)

Step	Procedure

ER (10^{-3} to 10^{-13}) and EC = 0

19 Repeat step 15.

20 Set the transmitter Error Addition and receiver Gating Period for each step in Table 6-24. Then, press the receiver MEAS [START/STOP] key and confirm that the output voltage is the same as that in Table 6-24 when the gating period ends.

Table 6-24 ERROR RATE OUTPUT Voltage Check

Step	Transmitter Error Addition	Receiver TIME Gating Period	Receiver ER/EC	Receiver Output Voltage
21	10^{-3}	10 s	1.00E-3	7.5 ±0.2
22	10^{-4}	20 s	1.00E-4	7.0 ±0.2
23	10^{-5}	30 s	1.00E-5	6.5 ±0.2
24	10^{-6}	30 s	1.00E-6	6.0 ±0.2
25	*1 [OFF | 10^{-6}]	1 minute	*2 5.00E-7	5.5 ±0.2
26	SINGLE 100 times	1 minute	1.20E-8	5.0 ±0.2
27	SINGLE 10 times	1 minute	1.20E-9	4.5 ±0.2
28	SINGLE 1	10 s	7.18E-10	4.0 ±0.2
29	SINGLE 1	2 minutes	5.98E-11	3.5 ±0.2
30	SINGLE 1	12 minutes	9.97E-12	3.0 ±0.2
31	SINGLE 1	2 hours	9.97E-13	2.5 ±0.2
32	OFF	1 s	EC = 0	0.0 ±0.2

*1 Leave OFF for 30 seconds, then, set it to 10^{-6} for 30 seconds.

*2 The error rate will vary from 4.00E-7 to 6.00E-7 depending on the time in *1.

Set the transmitter Error Addition for steps 25 to 31 while the receiver gating is in progress and set steps 21 to 24 and 32 before gating is started.

APPENDIX

OPERATION MANUAL

DIGITAL TRANSMISSION ANALYZER

ME520B EXTERNAL DATA

(OPTION 04)

ANRITSU CORP.

CERTIFICATION

ANRITSU CORPORATION certifies that this instrument has been thoroughly tested and inspected, and found to meet published specifications prior to shipping.
Anritsu further certifies that its calibration measurements are based on the Japanese Electrotechnical Laboratory and Radio Research Laboratory standards.

WARRANTY

All parts of this product are warranted by Anritsu Corporation of Japan against defects in material or workmanship for a period of one year from the date of delivery. In the event of a defect occurring during the warranty period, Anritsu Corporation will repair or replace this product within a reasonable period of time after notification, free-of-charge, provided that: it is returned to Anritsu; has not been misused; has not been damaged by an act of God; and that the user has followed the instructions in the operation manual.

Any unauthorized modification, repair, or attempt to repair, will render this warranty void.

This warranty is effective only for the original purchaser of this product and is not transferable if it is resold.

ALL OTHER EXPRESSED WARRANTIES ARE DISCLAIMED AND ALL IMPLIED WARRANTIES FOR THIS PRODUCT, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO A PERIOD OF ONE YEAR FROM THE DATE OF DELIVERY. IN NO EVENT SHALL ANRITSU CORPORATION BE LIABLE TO THE CUSTOMER FOR ANY DAMAGES, INCLUDING LOST PROFITS, OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, ARISING OUT OF THE USE OR INABILITY TO USE THIS PRODUCT.

All requests for repair or replacement under this warranty must be made as soon as possible after the defect has been noticed and must be directed to Anritsu Corporation or its representative in your area.

Copyright (c) 1987 by ANRITSU CORP. Printed in Japan.
All rights reserved. No part of this manual may be reproduced in any form without written permission of ANRITSU CORP.

TABLE OF CONTENTS

		Page
SECTION 1	GENERAL	1-1
SECTION 2	COMPOSITION AND SPECIFICATIONS	
2.1	Composition	2-1
2.2	Specification	2-1
SECTION 3	OPERATION	
3.1	Setup	3-1
3.2	Procedure	3-1
SECTION 4	APPLICATION (THROUGH JITTER MODULATION)	
4.1	Function	4-1
4.2	Setup	4-2

SECTION 1

GENERAL

The following operations can also be performed on any pattern data other than the PRBS and 1 to 16 bit WORD when OPTION 04 EXTERNAL DATA is provided for the ME520B.

1. Code conversion
2. Error addition
3. Jitter modulation

SECTION 2

COMPOSITION AND SPECIFICATIONS

2.1 Composition

Table 2-1 lists the composition for OPTION 04 EXTERNAL DATA.

Table 2-1 Composition

Item	No.	Name	Qty.	Remarks
Mainframe	1	OPTION 04 EXTERNAL DATA	1	Built-in to ME520B (Transmitter)
Accessory	2	Operation manual	1	

2.2 Specifications

Table 2-2 lists the specifications for OPTION 04 EXTERNAL DATA.

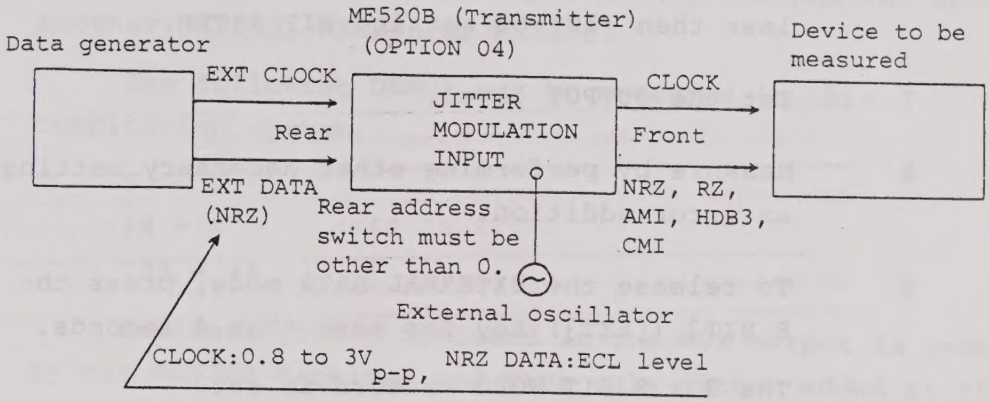
Table 2-2 Specifications

Item	Specifications
Input signal	CLOCK signal and NRZ signal
Input frequency	1 kHz to 150 MHz
Input level	CLOCK: 0.8 to 3 Vp-p
	NRZ: ECL level
Input impedance	75 Ω
Time difference between input clock and input data (NRZ)	1 ns or less

SECTION 3

OPERATION

3.1 Setup



3.2 Procedure

Step	Procedure
1	Connect as shown in the above diagram.
2	Set address switch to other than 0.
3	Turn on the power.
4	Press the [2 x 8 BIT] ([EXT]) key for more than 4 seconds to enter EXTERNAL DATA mode. "E" is displayed.
5	Set BIT RATE to EXT and set FORMAT to be output.

(continued)

Step	Procedure
6	To add jitter to output signal, set JITTER MODULATION mode and then set BIT RATE to EXT CLOCK (Jitter modulation is applied to the EXT CLOCK of less than ±10% of setting BIT RATE).
7	Set the OUTPUT level.
8	Measure by performing other necessary settings such as error addition.
9	To release the EXTERNAL DATA mode, press the [2 x 8 BIT] ([EXT]) key for more than 4 seconds. The 2 x 8 BIT WORD pattern is set.

Notes:

1. Time delay between rise of the CLOCK signal input to the ME520B (transmitter) and the raise or fall of the NRZ DATA must be set to between 0 and 1 ns.
2. The GP-IB command of the EXTERNAL DATA mode is "EXD".

SECTION 4

APPLICATION (THROUGH JITTER MODULATION)

4.1 Function

Tolerable DEMUX input jitter values can be measured by combining the ME520B (with option 04), the MH370A, and another ME520B, ME520A or ME520C.

The following DEMUX can be measured in this combination system.

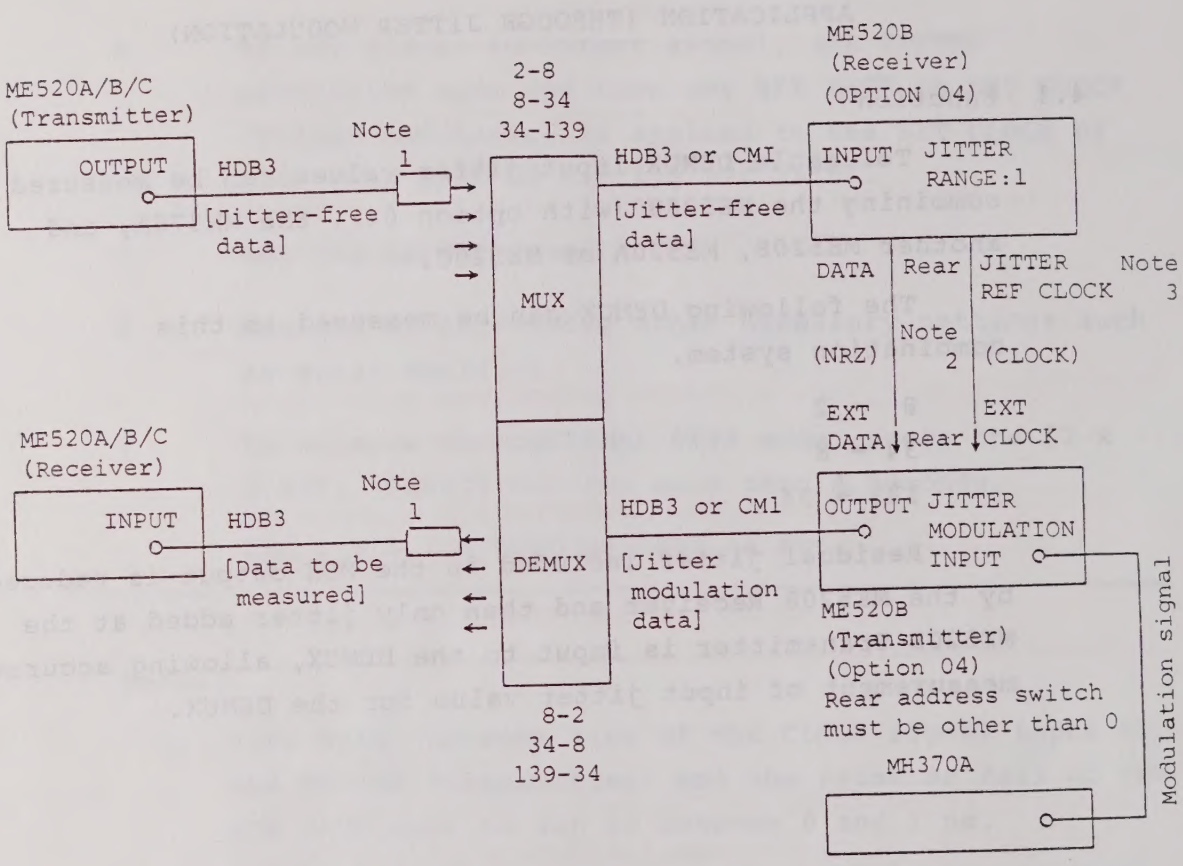
8 → 2

34 → 8

139 → 34

Residual jitter included in the MUX output is reduced by the ME520B Receiver and then only jitter added at the ME520B Transmitter is input to the DEMUX, allowing accurate measurement of input jitter value for the DEMUX.

4.2 Setup



Note:

1. Use MP35A for 120 Ω interface.
2. The CLOCK and DATA cables connected between the ME520B (Receiver) and ME520B (Transmitter) must be the same length.
3. Set the JITTER REF CLOCK at the rear of the ME520B (Receiver) to INT (set ADDITIONAL FUNCTION F switch to 1.)

MP MASTER
MA30369